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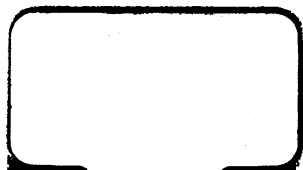
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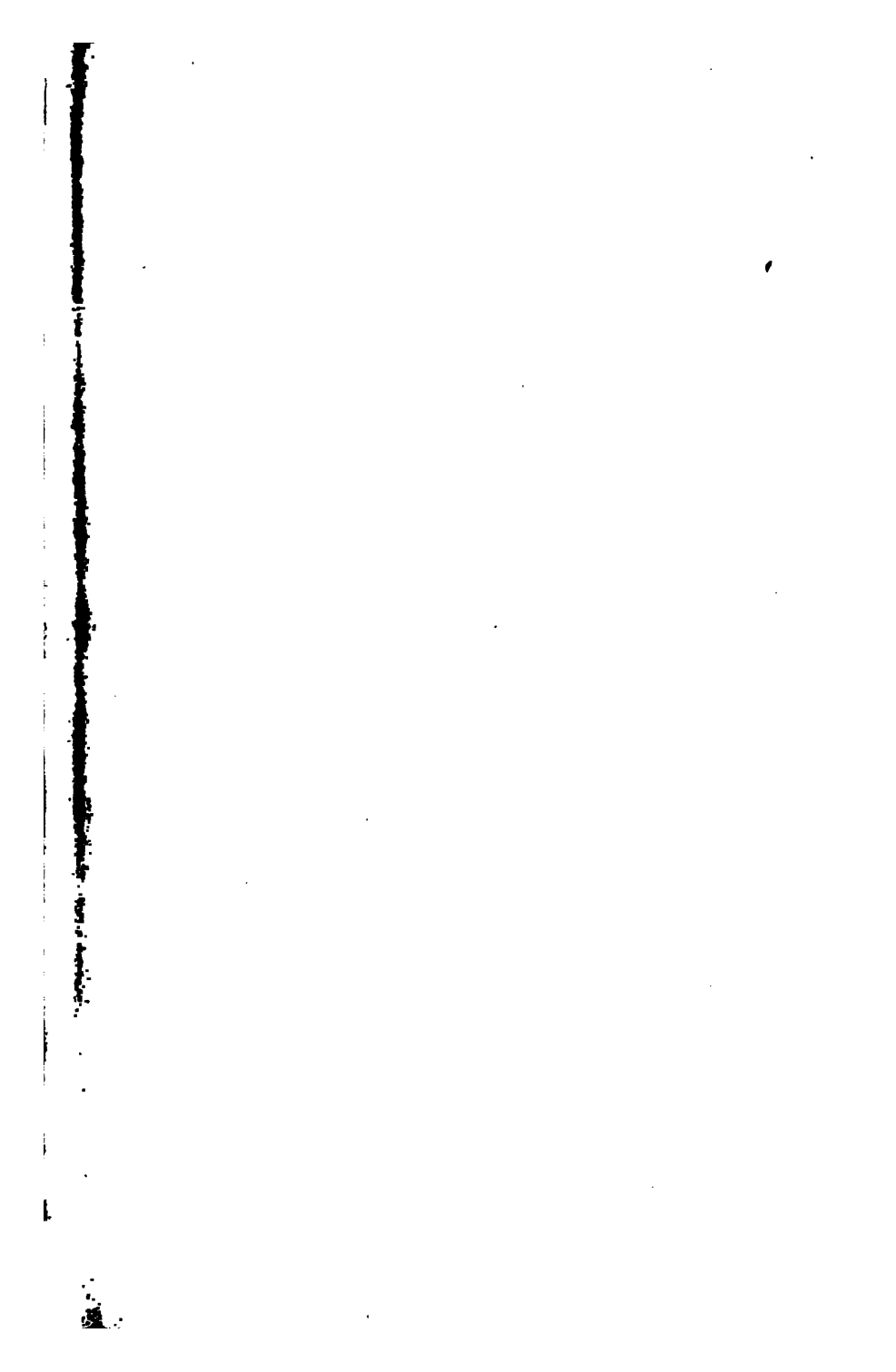
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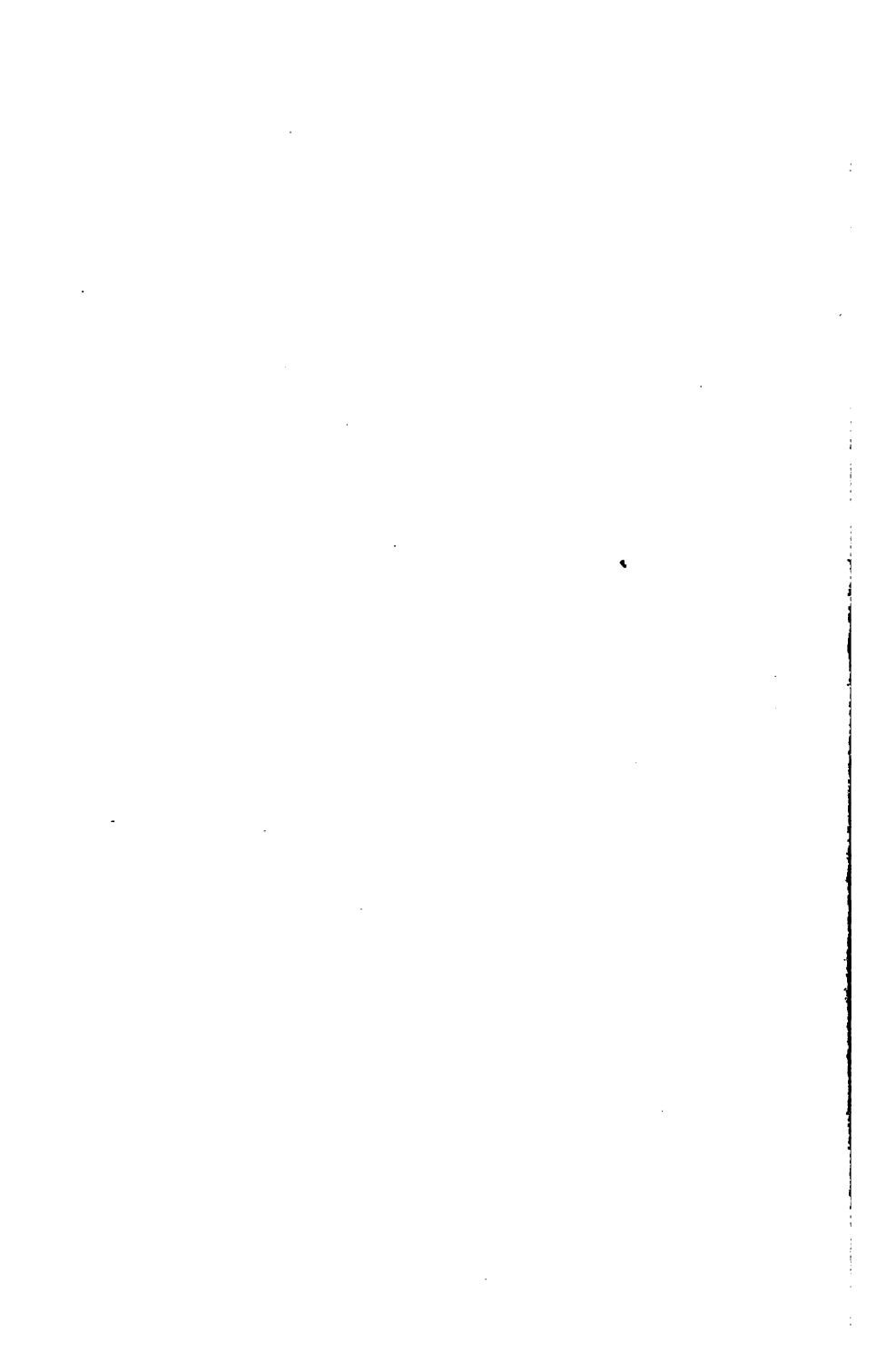
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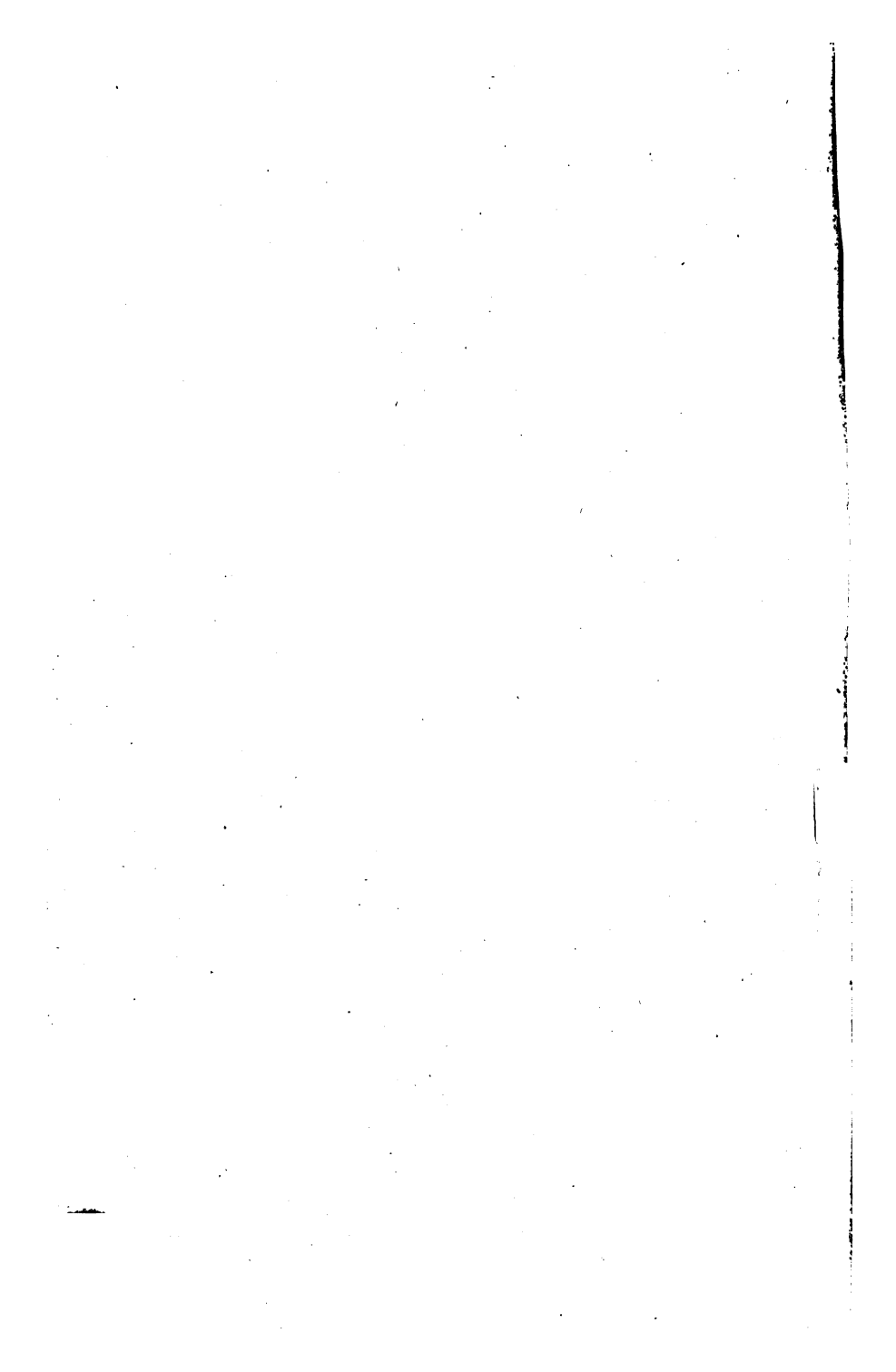
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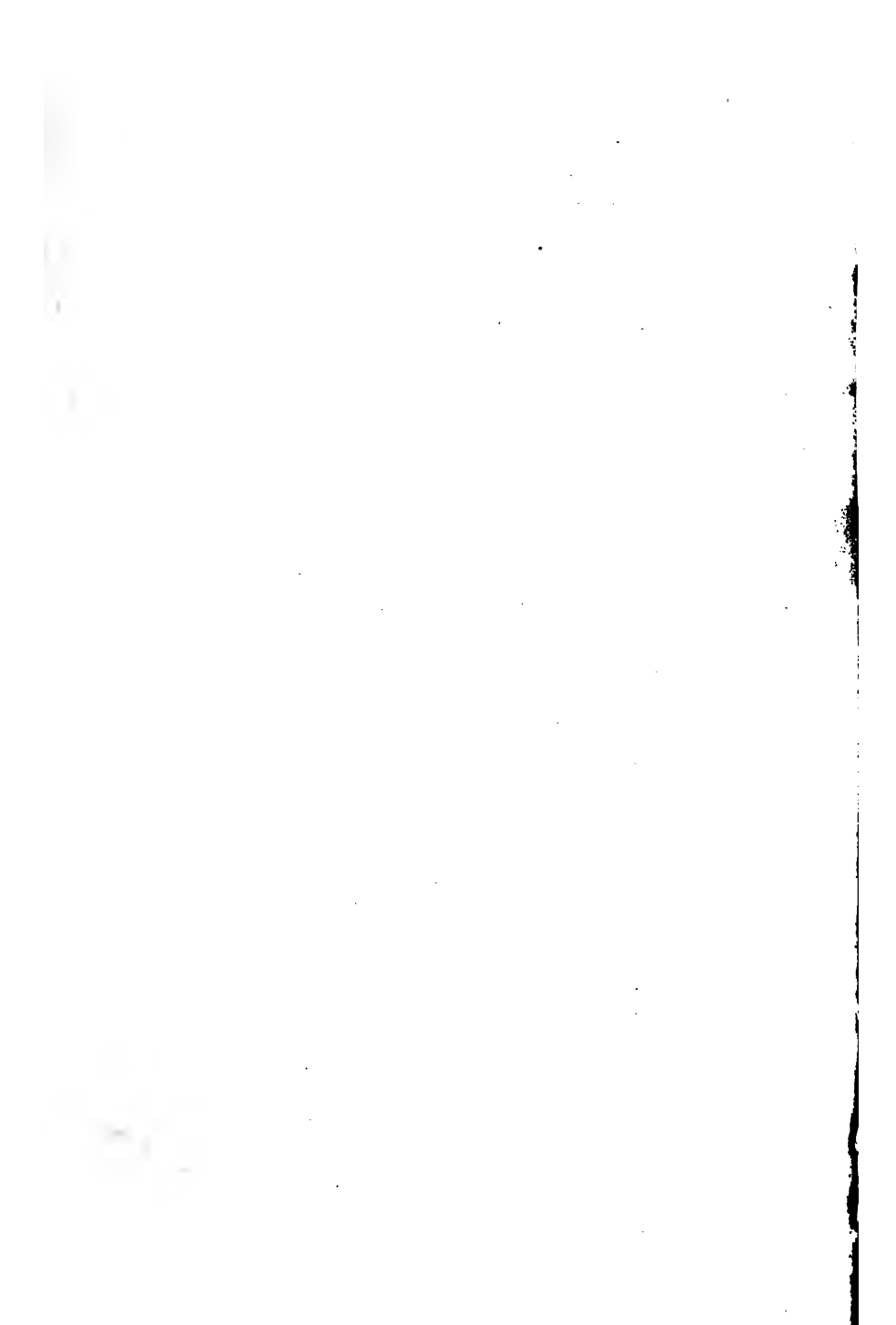
AMERICAN MEDICAL ASSOCIATION,

At Washington, D. C., May 5-8, 1891.

CHICAGO
PRINTED AT THE OFFICE OF THE ASSOCIATION.
1891.

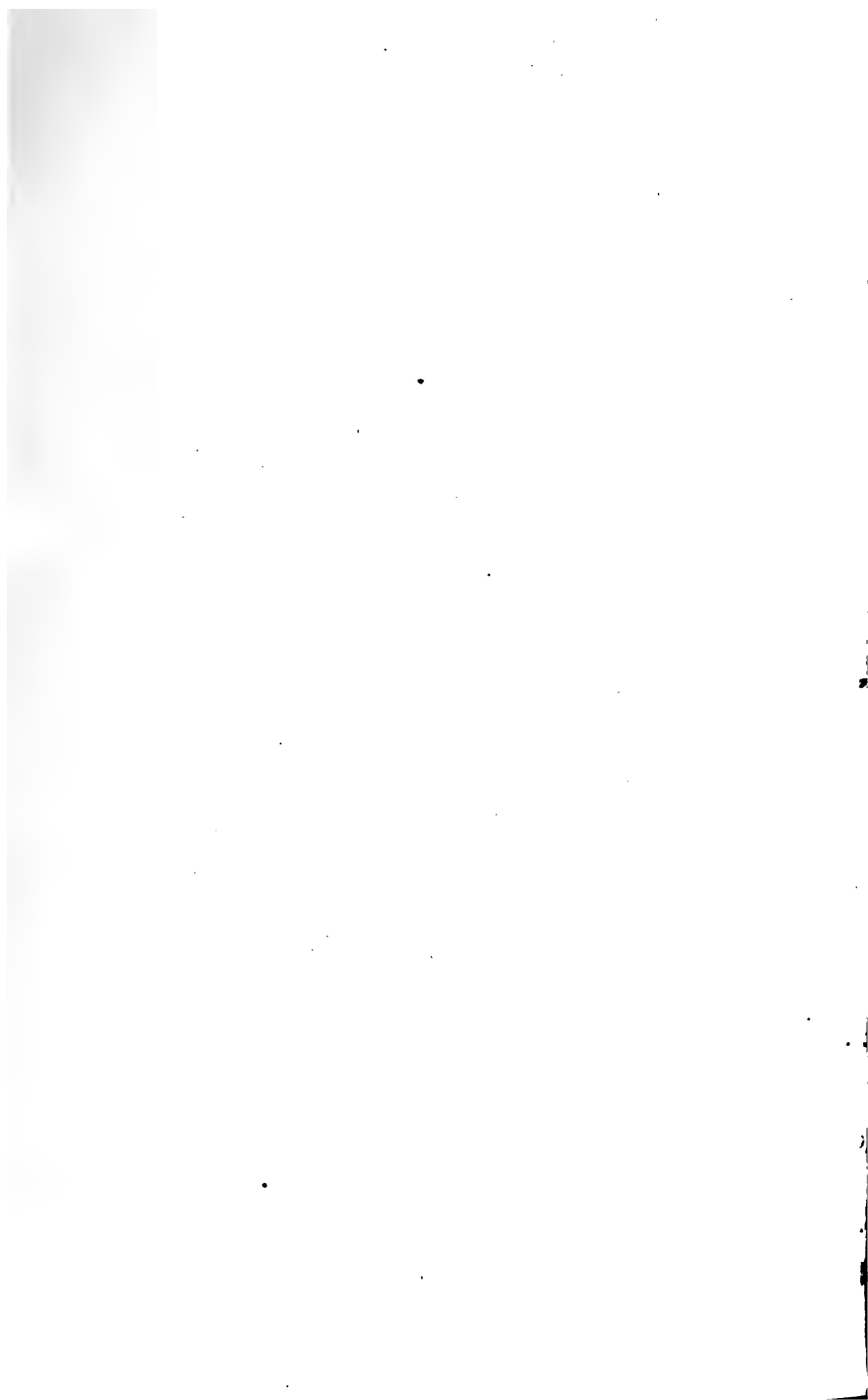


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THE SCIENTIFIC RATIONALE OF MOD- ERN WOUND TREATMENT.

BY HENRY O. MARCY, M.D.,
OF BOSTON, MASS.

The currents and counter-currents of surgical opinion, which dominate the methods of wound treatment, are perhaps nowhere better illustrated than at present in the public hospitals of London. In one of these the great founder of antiseptic surgery explains to his pupils and a very considerable number of surgeons, who gather daily in his wards from all parts of the world, the fundamental principles upon which his methods are formulated. These he exemplifies with painstaking care in the great variety of operations which are done in the amphitheatre of a large general hospital. It is noteworthy to observe that drainage is considered far less important than was earlier taught, although every wound is dressed with ample provision for protection from extraneous contamination, with the expectation that there may be, at least, a certain amount of serous or bloody fluid escaping from the

wound, which must be prevented from becoming infected. Mr. Lister now feels certain that the double cyanide gauze is by far the best protective dressing that has yet been devised.

In Guy Hospital carbolic spray may be seen in daily use, as a still further protection during the dressing of wounds, which is usually done at the bedside in the wards. In another hospital all this is openly abandoned, and antisepsis is not only considered useless, but harmful. Here, however, it is noteworthy to observe that the so-called system of cleanliness, which is emphasized, is antiseptic so far as it is possible to destroy the septic material with which, in life, all individuals are usually surrounded and must necessarily come in contact. This pertains especially to the field of operation, the operator, his assistants and the material used by them.

In Birmingham the surgeon, most often heard from, in unmeasured terms scouts all the processes pertaining to antiseptic surgery as "illogical and unscientific"; claims that even the vital tissues themselves in a state of health have ever present in them infective material, and that the dominating surgical thought of to-day is already an exploded fallacy, and that the system so elaborately constructed by Professor Lister is "as dead as Julius Cæsar."

In the great hospitals of Berlin there is a singular uniformity of both antiseptic and aseptic methods, revolutionizing all the work of the earlier days, both in technique and results.

In America, where opinion has its expression with the greatest degree of freedom, individuality is more noteworthy, and, although the teaching of surgery in the great centers of learning is largely based upon the fundamental principles as elaborated by Sir Joseph Lister, there is too often seen a carelessness of method, especially in detail, and corresponding imperfect result which indicates either a disbelief in, or an imperfect knowledge of what, for my own part, I had supposed long since considered demonstrated.

It is wise and ever profitable analytically to review, with critical care, our own convictions and experiences. This is not alone philosophic, but in large measure the way in which advancement may be made, and oftentimes leads to the condemnation and abandonment of our own most cherished ideas, resulting in the adoption of new means by which to reach a given end. Only by such measures can the individual himself become progressive, and keep apace with the tide of accumulated observations, with the assimilation of new truths, and himself become an important contributor to the advancement of science.

In this spirit, and not as a partisan, do I purpose to claim the attention of the Section to a brief discussion of the scientific rationâle of wound treatment, necessarily brief, although it were easier to write a volume than to attempt a correct presentation of the subject in the short time at my disposal.

So omnipresent is the appearance of vital activ-

ity in all organic material we cannot wonder that it long went unchallenged as an inherent factor. The ever illusive search for the beginnings of life led to the belief in a spontaneous generation, under favorable conditions, and to the solution of this problem we are first of all indebted, as the foundation of subsequent demonstration. Here Pasteur, Tyndall and many others of scarcely less note laid the foundations of a practical science, as wide-reaching as humanity, the importance of which hardly dawned upon their perception. In this connection it affords me the greatest pleasure to pay tribute to one of my earliest and most loved teachers, the late Prof. Jeffries Wyman, of Cambridge. In the *American Journal of Science and Arts*, vol. 34, July, 1862, Prof. Wyman gave an account of some experiments on the formation of infusoria in boiled solutions of organic matter, the result of which was that such solutions, exposed only to air which had passed through iron tubes, heated to redness, became the seat of infusorial life; the same results followed when similar solutions were enclosed in hermetically sealed flasks, and subsequently exposed to the action, for a short period, of boiling water. In a few instances, infusoria appeared when the temperature was raised above 212° F.

He says: "All living beings found under the above circumstances have been attributed either, 1st, to organisms, or the germs of them, supposed to be contained in the fluid experimented with,

or the air included in the flasks; or 2nd, to the direct transformation of organic matter into new living beings, independently of any germs, or living organisms whatever; or in other words, to 'spontaneous generation.' Abundant proof has been brought forward to show that the spores or germs of infusoria exist in the air in quantities amply sufficient to account for the presence of living organisms in solutions freely exposed."

"There can therefore be no certainty of the existence of spontaneous generation in a given solution, until it can be shown, that this has been freed of all living organisms which it contained at the beginning of the experiment, and kept free of all such from without during the progress of it. On the other hand, this kind of generation becomes probable, whenever it is made certain that infusoria do appear in solutions, in which the conditions just mentioned have been complied with."

For the purpose of determining whether infusoria can develop in organic fluids freed from living organisms which are kept secluded from atmospheric contact, Dr. Wyman entered into a long series of experiments with boiled solutions of organic matter in sealed flasks, which experiments were published in the *American Journal of Science and Arts*, September, 1867. The material used was an albuminoid product; usually boiled and filtered beef juice. The experiments were twenty in number and each usually consisted of a series of flasks, subject to a great variety

of exposures. The contents of the flasks were afterward carefully studied by himself and Prof. Henry J. Clarke, and the different varieties of bacteria were diagrammed, as seen under the microscope, enlarged from two to four thousand diameters. Prof. Wyman arrived at the conclusion, that at the temperature of boiling water, when continued for a sufficient period, the organic solutions contained in the flasks were completely sterilized, and that no matter what the surroundings or conditions, the fluid remained sterile until again brought into contact with the atmosphere. Under recent date, Dr. Morrill Wyman, of Cambridge, brother of the late Professor Jeffries Wyman, wrote me that some of the flasks used in these original experiments still remain with contents free from any evidence of life.

These original researches, by one of America's most distinguished investigators, are worthy of permanent record in the relation which they bear to antiseptic surgery. It seemed but a logical sequence that the introduction of these low forms of organic life into the albuminoid secretions of wounds would there germinate and be the legitimate cause of subsequent decomposition, producing all the train of evils incident to suppurating wounds.

Having once demonstrated that the cause of decomposition in organic fluids was due to an extraneous something, usually everywhere present, and that *that something* consisted of certain definite forms of life introduced into them from

without, these factors were plainly applicable to the treatment of wounds, and in this commenced the monumental labors of Mr. Lister.

The question, naturally, soon broadened out to determine, if possible, the varieties of bacteria which develop within the organism during the life of the higher animals, the peculiar conditions incident to their growth, and if certain varieties were more harmful than others. In other words, it became necessary to study *de novo* certain chapters of natural history, involving several families of the lowest orders of plant life. All this is now recognized as so important, that bacteriological researches, from the standpoint of laboratory investigations, are included in the curriculum of all the better equipped universities. These additions having been made to science, it naturally followed that, when the conditions of bacterial reproduction were known, it was then, and not *until then*, that the investigations of changed relationships which would limit, restrict, or prevent, their development could be intelligently undertaken.

Many of these investigations have borne fruitage of the greatest value to the human race. We now have the scientific demonstration of this in man, in the easy control of small-pox by vaccinia, established by the immortal Jenner; in the lower animals, in the valuable illustration of the same teaching by Pasteur in chicken cholera, and in the more recent and by far more important original investigations and demonstrations by

Dr. Frank Billings, of Nebraska, in the limitation and control of hog cholera and some of the diseases incident to the bovine race.

Very naturally this line of research has been extended, until it may be accepted as demonstrated that the large share of contagious and infectious diseases to which the human race is liable, are due to the introduction within the organism of a variety of spore plant growth, the development of which is the causative agent of the given disease. I need only to refer to the oft-repeated and generally accepted demonstrations of these important truths as illustrated in anthrax, cholera, tuberculosis, pneumonia, diphtheria, typhoid fever, measles, scarlet fever, etc.

Although quite a variety of other forms of growth may be introduced into the human system and germinate to the production of disease and death through the medium of an open wound, as for instance, anthrax, or diphtheria, it was speedily demonstrated that the poisoning of wounds was chiefly due to the micrococcal or round-celled growth. It was shown that these could be isolated, cultivated artificially, that they bred true, and upon reintroduction into wounds they always produced the same general class of symptoms and poisoning. Familiar illustration of this is found in erysipelas.

To show the fallacy that all organized material possesses in itself the means by which decomposition may go on spontaneously, a, so-to-speak, inherent bacterial infection of low order, the

early experimental observations of Prof. Wyman already alluded to, then demonstrated that the vital organisms contained in organic fluids were destroyed by the simple process of prolonged boiling, or by a retention for a considerable period at the heat point not above 212° F. A much more simple series of experiments unquestionably show that organic fluids, introduced into sterilized flasks without bacterial contamination, do not undergo decomposition, although freely exposed to atmospheric contact, provided that there is a protection of a slight packing of sterilized cotton which serves to filter out the germs of decomposition commonly present in the atmosphere. This is easily demonstrated in urine, or blood exposed to very considerable elevations of temperature, and these highly organized fluids remain sterile; unchanged indefinitely. The exposure of these same fluids to the atmosphere of a common living room, by the simple removal, for a few minutes, of the cotton protective, is sufficient to cause a rapid decomposition to ensue by the development of atmospheric germs coming in contact with them. This is shown to be a fundamental fact, pertaining not only to the fluids of the body, but equally also to the organized tissues, when treated in a manner that shall exclude from the same, the extraneous germs of decomposition.

In reply to an able and exhaustive argument by Professor James L. White, of Philadelphia, upon the present position of antiseptic surgery, Mr. Tait, of Birmingham, publishes in the *British*

Medical Journal, February 14, 1891, a defense of his position, from which I am constrained to make an extract, since Mr. Tait is so often quoted as an authority to prove the uselessness of what is called the antiseptic system of wound treatment: "Fortunately for my present purpose, Prof. White puts the issue syllogistically, and formulates for both of us a major premise upon the truth or error of which depends the whole conclusion; and I accept this issue freely. I say that germs of decomposition exist already in the blood and elsewhere in the body and are ever present, but do not bring about their results till death, or some condition which we may call a tendency to death, gives them permission so to do. Professor White says that the elaborate and carefully conducted experiments of Houser, Watson, Cheyne, and others completely contradict the statement 'which is really the foundation of Mr. Tait's argument.' In reply, I say I care not a straw for elaborate and carefully conducted experiments, no matter at whose hands, when their conclusions are diametrically opposed to every day experience." . . . "In truth the facts of the housekeeper and the henwife are far more scientific, that is, far more exact than those of our biological experimenters. They are in harmony with what I see in my work every day and therefore it seems to me a perfect waste of time to follow Professor White beyond his own major premise, which is utterly mistaken."

It may be accepted that the proof of the mis-

take in the major premise, as based upon such demonstrations, will not be received by the profession, as scientific, or determined, and to me it seems, in large measure, a waste of time to attempt to refute them. Really the housekeeper bases the entire art of preservation of all her organic compounds upon the demonstrations of Professor Wyman, already referred to. Upon these has developed the preservation of the food products, by the canning system in use in the various parts of the world. In America the meats of Texas, the fruits of California, the salmon of Alaska, are familiar illustrations of great economic commercial value in supplying our daily wants, giving employment to thousands of people and furnishing a product of an annual value of many millions of dollars.

We might broaden the inquiry to the natural decomposition of fruits and vegetables, including all the grains. Break the epidermal cells of the skin of the grape, the orange, pear, or apple, and all know the rotting of the fruits by the rapid development of a low order of new growths. All the starchy seeds, bulbs, and grains, are protected by an impermeable envelope during their so-called sound state. There is no vital force which holds in preservation these starch cells, they are simply stored up, like the albuminoid products of the egg, to serve as food in the development of the germinal cells in the earlier stages of reproduction, until the plant has reached a stage

of evolution with sufficient inherent power for an independent existence.

If I understand at all what is meant by the demonstration of the henwife, it is simply this and nothing more, that the vitalized ovum is surrounded by a mass of nutritive material, enclosed for its better protection in a porous casement of lime salts, which albuminoid material contained therein is utilized for the development of the growing chick and dominated by vital forces, which elements become parts of a vital organization in precisely the same manner as when the independent individual utilizes its food, which in later life is received into the organism through the alimentary canal. The chief difference that pertains in the characteristics of the growing organism, is that in the oviparous animals the nutriment necessary for the development of the ovum is emitted in a mass sufficient for the purposes of the economy of complete development, while in the mammalian vertebrates the foetal nutrition, by the process of secretion and absorption, is elaborated *pari-passu* to meet the necessities of the individual development. In the one instance, the egg, when devitalized, speedily undergoes bacterial decomposition, introduced through the protecting envelope from without. In the other, as Mr. Tait should well know, the foetus, having perished within the uterus, undergoes a process of maceration, but never decomposition, unless by the introduction of germs from without. Therefore, it is evident that Mr. Tait's major pre-

mise, as he understands it, based upon the scientific deductions of the housekeeper and henwife, are subject to revision, and indeed, when carefully studied, are strictly in accord with the scientific observations, as daily conducted in our better laboratories.

The problem confronting the surgeon is easily subdivided into the two chief factors viewed from the aspect of strict science. The first factor, based upon the accepted premise which I am sure few would have the hardihood to consider "illogical and unscientific," is that the vital organism with which surgery has to deal in itself, in health, is free from bacterial ferment, protected from without by a coat of mail, when unbroken impermeable to invasion, and from within through its mucous surfaces by a similar disposition of protective cells, is that all operative wounds made in such tissues should be, as far as possible, made and maintained aseptic; the second, when septic, to determine the best measures for the destruction of the infecting organisms. The wounds of the first class are liable to extraneous infection from everything with which they may come in contact, and hence the necessity for sterilizing the surroundings and the material applied. It is sufficient for our present purpose to omit reference to the manipulative detail, as to the means to be used to secure this end. I cannot myself doubt, but that the justly discarded and much abused carbolic spray, in the earlier stages of the problem, served as a valuable means in securing

good results. Irrigation proves a far better substitute and in the present state of our knowledge cannot safely be dispensed with. A wound in uninfected tissues should be aseptic, as far as possible freed from devitalized structures, carefully approximated, and held at rest. It should be maintained aseptic by the application of suitable dressings.

The second factor of the problem is a much more difficult one. How to treat a wound made in tissues which are already infected, or to best care for a wound which has by accident become the seat of septic ferment, is a subject upon which there is great difference of opinion. Anything like a satisfactory discussion of the problem confronting us demands the careful study of the varying conditions of the individual, the vital, resistant power of the infected organism, as well as the character and amount of the infection itself. The individualistic resistant force is a constantly fluctuating factor, naturally greater in young life and lessening in accordance with age, surroundings, habits, etc. Bacterial growth in dead tissue, under favorable conditions, goes on to the entire decomposition of the material.

When introduced into the living tissues in small quantity, although the heat point and albuminoid products for its food are ever present, the vital, resistant power of the organism may be such that the bacterial ferment will not germinate at all, or in such a limited degree that at the most the disturbing conditions are strictly lo-

cal and soon disappear. Under favorable circumstances, the resultant suffering and danger are in direct ratio to the amount of the infected material introduced into the organism, and this may be in such quantity as to entirely overcome the resistant power and rapidly cause its destruction. The character of the seed introduced also varies greatly, the reproducing power of some ferments, as anthrax, being such as no matter how small the quantity greatly to endanger the individual. Not seldom the prick of a needle, carrying a minute portion of bacterial infection from a dissection wound, may introduce a virus into certain localities, where its rapid reproduction produces speedy death, while many of the atmospheric germs, common to all localities, reproduce only feebly under the most favorable conditions and soon disappear.

In tracing out the processes which a healthy organism has at its command, it is of intense interest to note the manner in which Nature rallies her forces for resisting invasion. The profession have long been familiar with the rapid proliferation of cell character which goes on about a wound, and these changes have been more or less carefully studied from the beginnings of surgery. My earliest teacher in medicine, the late George A. Otis, Surgeon of the United States Army, whose monumental labors in the elaboration of the surgical history of the late War of the Rebellion won for him enduring fame, emphasized the observation that the so-called pyogenic membrane

in abscesses was in reality protective to the surrounding parts and was not to be interfered with by surgical manipulation.

We now know that the leucocytes, so familiar to all versed in histological study, are endowed with a peculiar physiological power. One of the first processes which we are wont to observe under the name of inflammation, we find consists in a rapid proliferation of the white cells about the point of invasion, encapsuling, as it were, the foreign material. That they do more than this, having the power to surround and destroy, so to speak, under favorable conditions, to digest the bacteria is now generally well known, thanks to the observations of Metschnikoff. Although it is quite too early to draw general deductions from these facts and declare that the entire solution of the so-called vital, resisting power of the tissues lies in this power of the leucocytes, there is every reason to believe that this important discovery gives an explanation of satisfactory type to certain of the hitherto unexplained factors in the repair processes of wounds. In the repair of the minor subcutaneous injuries we have familiar illustrations of the part which the leucocytes play in the animal economy. The effused blood is surrounded by them, and the material of the exudate is appropriated for their own development. Minute capillary vessels are formed in the line of these invading cells and the process of clot disappearance and granulation tissue development go on *pari-passu* until the clot has

disappeared and new connective tissue restores the part to its former condition.

When a small colony of micrococcal cells have found lodgment, the leucocytes surround and shut in the enemy, until a wall of living granulation cells are formed, forcing it to surrender, and a localised abscess is the sum total of damage.

If we find in these familiar leucocytes, the so-called phagocytes of Metschnikoff, empowered to a certain extent with the ability actually to destroy infecting bacteria, we certainly have in a very considerable measure an explanation of the vital resisting power of the individual organism. If, under favorable circumstances, these cannibalistic little workmen, not alone surround, but actually eat up, their enemies, we have the best of reasons for understanding why the comparatively few germs in the atmosphere of an healthy locality are far less dangerous to wounds than was earlier supposed.

Again we understand why in the so-called surgically clean wound, a wound where great care is taken to exclude foreign material, and the comparatively uninjured clean-cut surfaces are closely approximated, the reparative processes go on steadily, and rapid recovery supervenes, although in a strictly scientific sense, the wound may not be aseptic. The infected organism suffers in a two-fold manner. First, locally, that is, in the wounded surface and its immediate neighborhood, and in a general constitutional

poisoning. The latter is produced by a chemical substance capable of isolation, called sepsin. This may in itself be sufficient to cause death, and its importance can hardly be overestimated, but since it is the direct result of microörganic development, it follows that the control, or destruction, of the organic ferments is the sure way of cutting off the septic, systemic suffering.

In this process, the methods which have been emphasized as aseptic, or surgical cleanliness as in contra-distinction to antiseptis, bear no part except so far as they may aid in removing the products of decomposition. The prerequisite knowledge in this instance must be sufficient to enable the best trained surgeon to make use of those agents best fitted to destroy the organisms in loco with the least possible injury. Hence the wide field of research of a most painstaking and scientific character which must of necessity be traversed before a satisfactory solution of this question could be given. Now, we have the fruitage of a multitude of patient investigators; notably Mr. Lister and Mr. Cheyne, of England, Pasteur in France, Koch in Germany, Sternberg, Cabot and others in America. My own publications upon this subject were the fruitage of two years of carefully conducted laboratory experiments.

The mercuric-bichloride solutions are usually greatly to be preferred as more effective as a destroyer of infection and less irritant to the wounded surface. All pockets in suppurating

wounds must be carefully cleansed and drained, while in iodoform we fortunately have an agent, the crystals of which are only in a minor degree irritant, and as such absolutely non-poisonous. They dissolve very slowly and are germicidal only in solution. Hence by their use bacterial development is greatly retarded, if not altogether prevented. The iodoform crystals in most wound secretions, as ordinarily observed, dissolve so slowly that the antiseptic power is continued as a constant factor for hours, sometimes even for days together.

From this hasty, and necessarily imperfect, review of a subject second to none in interest or importance to our entire profession, we have omitted of necessity very much of value. However, I am certain that "the better methods of wound treatment have a fundamental basis of a strictly scientific character, the three important factors of which are: *First*, the vital resistant power of the individual. *Second*, the character and amount of the bacterial infection. *Third*, the local condition of the tissues at the seat of implantation.

The ideal treatment of wounds is certainly the restoration of the condition of the parts operated upon to, as nearly as possible, their primal state. If this can be effected aseptically, then there are no bacteria to be removed, and if the wound is surgically clean, with accurate coaptation of the sundered parts, then the vital forces are sufficient to utilize any resultant exudates, and drainage

is not alone superfluous, but harmful. The reparative process should go on under a dressing which will permit of the introduction of no foreign factorage. The various antiseptic dressings now so generally used, have a value in wounds necessarily drained, that is subject to a probable infection, but in aseptic wounds primarily closed, they are unnecessary, expensive and cumbersome."

For quite twenty years I have been in the constant practice of closing *aseptic* wounds by lines of buried animal sutures. Little by little I have been led to discard drainage, almost without exception, in this entire class of wounds, until I have formulated it as a rule of practice, that no matter how large or deep in non-infected structures, the sundered parts are rejoined, oftentimes by the use of several feet of tendon suture, and the wound is sealed by a germ-proof dressing of collodion. To this rule the larger amputations are no exception, and such wounds thus treated rapidly heal without pain or oedema of the coapted tissues. In reality, it makes little difference by what name we call this modern miracle of surgical wonder-working. It has its establishment upon the foundations of pure science; its future gives promise of still greater achievement, and we may look forward with confident expectancy to the day when medicine and science, although they cannot be exact sciences, will be understood and practiced with a scientific rationâle above contradiction or reproach.

My brethren of a noble profession, second not even to that of the clergy, may I not be pardoned a digression? We have spent the last two days in the Councils of the Academy of Medicine intent upon the purpose of elevating the profession to a higher standard of education, comparing the advantages of a general, with those of a technical training. May we not accept that they both should be broadened in the Catholicity of Science which is after all the demonstration of God's own law of pure and simple truth? The one profession reads it in the Divine revelation transmitted through the Fathers; the other in the unerring law of vital forces transmitted from the beginning of creation. The one teaches a mediatorial redemption from the transgressions of the moral law; the other knows of no high-road cast up for the escape from the penalties attached to the infraction of its inflexible government.

Since both emanate from a common source and center of Being, should they not be at least equally respected, investigated and obeyed? He who studies the infinitely minute, and yet sees through it all the marvelous working of a vital law, intended primarily for the beneficent good of the created, is moved by the same divine inspiration as he who measures the infinities of space and weighs the distant stars in the balances of mathematical correctness. If I read aright the future of our great Republic in the evolution of our race, the time is not far distant when the

necessity of sending our young men to the great centres of European thought for a higher development in the training and knowledge of the exact sciences will have passed.

Let our own Central Government not alone foster the education of the masses as a bulwark of defence in the protection of our own inherent safety, but let her also provide National Laboratories which shall amplify the advantages of the Carnegie and Johns Hopkins institutions for biological researches, the advantages of which to the well being of the entire race can hardly be overestimated.

THE RELATION OF CONCUSSION OF THE
BRAIN AND SPINAL CORD TO IN-
FLAMMATORY AND OTHER
MORBID CONDITIONS IN
THESE ORGANS.

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It is certainly apparent to all the members of the medical profession that brain and spinal surgery has received during the last quarter of this century an unusual and likewise unprecedented amount of attention. It is likewise equally apparent that great progress has been made by those who are devoted to this branch of surgery; it therefore becomes highly necessary, that he, who is about to enter this field of medical literature, should first discover some dark spot or disputed question, on which he thinks he may possibly throw a few rays of scientific light. The traumatisms of the brain and its membranes have been more fully studied than those of the spinal cord. Undoubtedly this may be accounted for in

part by the fact, that the first mentioned organ is much more frequently the seat of these lesions than the latter. I shall therefore direct the greater portion of my attention especially to lesions following traumatic injuries of the spinal cord and its membranes.

It seems necessary to call attention to certain errors as a preliminary to the consideration of our first inquiry. One of the most important of these has been expressed by Mr. Erichsen in the following language:¹ "The consideration of the effects that may be produced on the spinal cord by *slight blows*, whether applied to the back or to a distant part of the body, is not altogether a matter of modern surgical study arising from the prevalence of railway accidents, but had, long antecedent to the introduction of modern means of locomotion, arrested the attention of observant practitioners." Since the above statement was made it has been clearly demonstrated to be erroneous by anatomical and experimental investigations. The anatomical studies have shown that the spinal cord is the best protected organ in the body, and experimentation has fully confirmed this position. The experiments which I made on dogs—the total number being 141—which were arranged and conducted for the especial purpose of producing concussive lesion in the spinal cord and its membranes fully convinced me that it required *a very severe blow*,

¹ On Concussion of the Spine. A New and Revised Edition. London: Longmans, Green & Co. 1882.

which must even be delivered on certain limited areas of the body, in order to accomplish this object. I am likewise satisfied that this conclusion must necessarily follow a careful study of my report entitled "An Experimental Study of Lesions Arising from Severe Concussions."²

It should be furthermore stated that the lesions produced in the spinal cord and its membranes were rarely apparent to the unaided eye, but were readily revealed under the microscope. This statement, however, does not apply to those cases in which there were either fractures or dislocations involving the vertebræ; since the lesions here were comparatively coarse.

The statement that a rupture of the spinal membranes has occurred, or that there has been a gross hæmorrhage into the substance of the spinal cord, or between the cord and its membranes, is certainly not entitled to credence unless coupled with the acknowledgment of either a fracture or a dislocation of a vertebra. This statement is based on my examination of the lesions found in the spinal cord, and its membranes, and I am so thoroughly convinced on this point, that I feel fully warranted in making this positive statement. The so-called "railway spine" includes true concussion arising from blows, falls, gunshot wounds, lightning strokes, electric shocks, etc., likewise contusions on the back, sudden flexions of the spinal column, sprains,

² P. Blakiston, Son & Co., Philadelphia, 1890.

wrenches, and twists. Dr. John A. Lidell says, in discussing the consecutive effects of some of these injuries, that:³ "Among the remote effects of *sprains, wrenches and twists* of the spinal column, are chronic *inflammation of the vertebral joints* that are implicated, which is, often suppurative in character, *destruction of the articular cartilages and the intervertebral substances* that are involved, and *caries or necrosis* of the adjoining vertebral bodies." In such cases, the destructive process begins more frequently at the junction of the vertebræ with the intervertebral substances than in the intervertebral substances or vertebræ themselves, because, as Mr. Hilton has pointed out, we know that in accidents, at least as far as we have been able to discover, "the most frequent lesion in injury to the spine is a partial severance of the vertebræ from the intervertebral substance."

A number of illustrative examples have already been presented, and inasmuch as this topic has already been pretty thoroughly discussed, no apparent need exists for presenting any additional instances of the same sort. I will, however, take space to present a very instructive case, in which there simultaneously occurred lumbo-sacral abscess and suppurative spinal meningitis, in consequence of a blow on the spinal column.

The following abstract made from the report of the history of this case supplies the essential

³ International Encyclopædia of Surgery, Vol. IV, p. 870 et seq. Edited by John Ashhurst, Jr., M.D., Wm. Wood & Co., New York. 1884.

points: A healthy lad, of 15 years, was struck by his playmate on the back with the fist. He thought little of it at the time, but was admitted to Guy's hospital nine days afterwards; was treated with leeches and somewhat recovered, but the pain soon returned and fever ensued. "An abscess formed on the right side of the sacrum, which was opened, and continued to discharge, the flow of pus being increased by pressure on the abdomen. He continued to get worse daily, having much irritative fever and severe pain in the back. During the last week of his life he was exceedingly restless, and often delirious; and he complained of pain in all parts of his body, but particularly in the extremities. On one or two occasions he had loss of power over the bladder and rectum, but had no other symptoms of paraplegia, and could move freely in bed." He died twenty-two days after the casualty.

Autopsy.—An aperture in the integuments at the right side of the sacrum led into a very extensive abscess, external to the peritoneum, which occupied the forepart of the sacrum behind the rectum, and external to the ilia on both sides behind the psoas muscles. The bones were exposed but not diseased. Although the abscess had discharged externally on the right, it was most extensive on the left. It had burrowed up to the left side of the last lumbar vertebra and the sacro-vertebral foramen into the spinal canal. When the theca was opened, it was found to contain a quantity of greenish pus, spread over its

inner surface and over the cord itself. The spinal dura mater (theca) at the point indicated, was softened and destroyed, and the cauda equina was lying bathed in pus which filled the sacral canal. The membranes of the cord were inflamed throughout the whole extent, and there was purulent effusion as high as the dorsal region. The spinal dura mater was thickened, and its inner surface had lost its smoothness and transparency, and was of a dull green color. Pus could be squeezed out from beneath the visceral arachnoid in considerable quantity. The spinal cord itself was firm, and the microscope revealed no morbid condition in its substance. On opening the cranium, traces of acute arachnitis were found over the whole surface of the brain, greenish-colored lymph being effused into the sub-arachnoid tissue, especially at the base. The inner surface of the dura mater, around the foramen magnum and on the adjacent part of the occipital fossa, was of a greenish color, from lymph effused upon it. Bronchial tubes filled with tenacious mucus. Lumbar and bronchial glands slightly enlarged. All other organs entirely healthy.

The purulent infiltration of the spinal meninges which was observed in this case, occurring coincidentally with the formation of a lumbar-sacral abscess, but without the production of paralysis, could scarcely have happened unless the sacro-vertebral articulation had previously been opened, both externally and internally, by disease of the articulation itself, in such a manner

as to allow the products of inflammatory action to flow freely out of it, as well as into the spinal canal. Otherwise the suppurative meningitis would pretty certainly have caused paralysis by compressing the spinal cord with its inflammatory products.

The clinical history of this lad's case, interpreted by the post-mortem appearances, appears to have been as follows: The blow on the back wrenched the sacro-vertebral articulation, and caused a suppurative inflammation to be lighted up therein, particularly on the left side; and in consequence of this, purulent matter escaped in an outward direction, and led to the formation of an immense lumbo-sacral abscess; it likewise escaped in an inward direction, and caused the theca vertebralis to become softened and perforated, and extensively destroyed, and a diffuse suppurative inflammation, which extended upward to the brain, to be kindled in the spinal arachnoid.

It has been aptly said that "in all science error precedes the truth, and it is better it should be first than last,"⁴ I have cited the case reported by Dr. Lidell, with all its details, in order that I might bring forward some of the results of my observations, made during my recent experiments, which afford a correct and rational explanation of the conditions revealed by that post-mortem examination. There will be found in

⁴ Walpole.

the report of my experiments eleven cases in which there was rupture of the ligaments of the sacro-lumbar articulation. There were marked pathological changes in the organs and tissues within the pelvic and abdominal cavities in six of these cases, which were immediately connected with the rupture of the ligaments of the sacro-lumbar articulation. Let me here present the following abstracts from post-mortem examinations, for the purpose of giving a correct idea of the lesions:⁵ "Autopsy. This examination revealed a rupture of the ligaments between the last lumbar and the first sacral vertebræ, deep and extensive ecchymoses over the entire post-sacral and right lumbar regions. A profuse extravasation of blood into the abdominal cavity, marked engorgement of the kidneys. Brain apparently normal, slight increase of the cerebro-spinal fluid in the cavities, and the cord was congested, to the middle of the dorsal region."

"Autopsy.⁶ This examination revealed the following lesions: Both kidneys congested; the chymosis in the connective tissue covering the anterior surface of the last lumbar and the upper sacral vertebræ. The brain and spinal cord apparently hyperæmic. The removal of the integument over the sacral and lumbar regions showed an ecchymotic condition of the muscles. There

⁵ An Experimental Study of Lesions Arising from Severe Concussions," by B. A. Watson, A.M., M.D., p. 32, Exp. 4.

⁶ *Ib.*, p. 35, Exp. 10.

had been a rupture of ligaments between the last lumbar and upper sacral vertebræ."

"Autopsy.⁷ This examination revealed the following lesions: Both kidneys congested; bladder distended with urine; extensive ecchymoses in the lumbar and pelvic regions, involving psoas muscles; brain perfectly normal. The spinal cord was hyperæmic downward from the lumbar enlargement, including a portion of the cauda equina; rupture of the ligaments between the last lumbar and the first sacral vertebræ." The essential point which Dr. Lidell has overlooked in his comments on the case which he has reported, are the pathological conditions of the organs and tissues within the pelvic and abdominal cavities. It was the *existence of these lesions which gave rise to the inflammation and suppuration* within these cavities. The post-mortem examination of Dr. Lidell's case sufficiently demonstrates this position. Dr. Lidell says:⁸ "the blow on the back wrenched the sacro-vertebral articulation, and caused a suppurative inflammation to be started up there." The autopsy in the case fails to show that there is any erosion of the bones or cartilage within this articulation, and its history reveals the fact, that it was only immediately before death that there was the slightest indication of paraplegia. It is therefore certain that the wrench which he mentions consisted in producing a rupture of the ligaments of the sacro-lum-

⁷ *Ib.*, page 40, Exp. 24.

⁸ Previously cited.

bar articulation, and likewise, as very frequently happens in those cases, some pathological lesions within the pelvic and abdominal cavities. The simple wrenching of any joint in a healthy subject unattended with pathological lesions, has been amply shown to be a comparatively trivial injury, which does not lead to serious inflammatory complications or death.

The one hundred and forty-one experiments, which I made on animals, does not afford a *single example* which justifies the conclusion that injuries to the vertebral articulations are a whit more serious than those produced in the carpal and tarsal articulations; and, consequently, analogous reasonings may be here employed with entire propriety. We cannot pass over the history of Dr. Lidell's case without pointing out a glaring absurdity, which may possibly have had its origin in carelessness. In this report we are informed that a healthy boy, aged fifteen, "while playing with another lad, received a blow on the back with the fist," and in the absence of any additional statement bearing on this injury, we are left to infer that the pathological changes and even the death of the patient were caused by this blow. He who has examined the anatomical structure of the spinal column will readily perceive the absurdity of this statement. The blow *inflicted was entirely inadequate for the production of the results* which followed, unless there has been omitted from this report the most important factor in the history of this case. It is

true the force of the blow might cause the lad to fall—and if at this point, the history of the case showed that the boy fell across a bar, raised a few feet from the ground, in such a manner that his feet remained on one side while his head was on the other, then the very important factor of leverage having been added, which would result under these circumstances in the production of a sudden flexion of the spinal column, would certainly bring within the limits of possibility the occurrence of the injuries which are reported in the autopsy.

It is scarcely necessary to mention the fact, that nearly all the injuries grouped together under the unfortunate cognomen of "railway spine"—so far as their remote effects are concerned—take their origin, either directly or indirectly, in inflammatory processes. Consequently the consideration of the following queries assume importance:

1. Do inflammatory and other morbid changes take their origin in traumatic injuries of the spinal cord and its membranes as frequently as the writings of Mr. Erichsen imply?

2. Do inflammatory and other morbid changes ever arise from traumatic injuries which are entirely uncomplicated by immediate symptoms?

3. How soon are the inflammatory and other morbid changes developed after the receipt of traumatic injuries in the cord, etc.?

In our consideration of the first question it is scarcely necessary to give a negative reply to

those who have perused the writings of Mr. Erichsen on this subject; since they have already reached this conclusion. Furthermore, the mere assumption that serious results frequently arise from wholly unimportant injuries *is not sustained* by clinical observations or experimental investigations. However, Mr. Erichsen, in writing of those cases in which the patient has received no blow or injury upon the head or spine, but in which the whole system has received a severe shake or shock, in consequence of which an immediate lesion, probably of a molecular character, is sustained by the spinal cord, and disease of an inflammatory character, or of a disorganizing nature, is developed in it, the inflammatory action eventually creeping up to the membranes of the brain, says that the cases "although *necessarily more frequent* in railway than other injuries, do occasionally occur as a consequence of ordinary accidents." A perusal of Mr. Erichsen's writings has completely failed to convince me that he has supplied any basis for the support of the opinion advanced in the above statement.

In order to demonstrate the correctness of this opinion, which conflicts with the positive knowledge we possess on this subject—and which cannot be supported by analogous reasoning—he should clearly establish the following facts, viz.:

1. *That no disease of the brain or spinal cord existed at the time of the occurrence of the alleged*

⁹ On Concussion of the Spine, Nervous Shock, etc., p. 95. New York: Wm. Wood & Co. 1875.

accident. 2. That the consecutive inflammation did arise from traumatism, and was not due in part, or wholly, to a vitiated constitution. This evidence is entirely wanting; and, consequently, we must maintain that Mr. Erichsen's statement should be excluded in cases of medico-legal evidence.

We have now devoted our attention to the consideration of the material points involved in our first query ; but it would seem proper in this connection to give some additional thought to the consecutive results of concussive accidents. Mr. Erichsen says :¹⁰ "Whatever may be the nature of the primary change that is produced in the spinal cord by a concussion, the secondary effects are clearly of an inflammatory character, and identical with those dependent on chronic meningitis of the cord and sub-acute myelitis." The term concussion, as employed in the above quotation, evidently refers only to traumatism of the spinal cord and its membranes, but elsewhere the same author in speaking of sprains, twists and wrenches of the spinal column, says,¹¹ "It is important to bear in mind that the vertebral column is more apt to suffer in these strains of the spine than in the other forms of injury that we are discussing, and that in serious cases the full force of the mischief appears to be expended in the spine itself independently of its contents, which escape uninjured." The views expressed by Mr. Herbert

¹⁰ *Ib.*, page 157.

¹¹ *Ib.*, page 128.

Page on this subject are as follows:¹² "Happily there is no doubt of the exceeding rarity of spinal meningitis as an immediate result of localized injury to the vertebral column; and I know of no case in which meningeal inflammation has been caused by injury of some part of the body remote from the spine." The experimental study of concussion of the spinal cord has satisfied me on the following points: 1. True concussion of the spinal cord from blows, falls, lightning strokes, etc., is an exceedingly rare occurrence. 2. Secondary results, such as inflammation, suppuration, etc., very seldom follow the traumatism—owing to the fact—that the punctate hæmorrhages, etc., are generally widely diffused in various parts of the spinal cord—while the pathological lesions are so slight as not to supply inflammatory foci. However, the danger arising from a true concussion of the spinal cord produced by gun-shot injuries, the lodgment of a musket or rifle ball in the spinal column, is attended with much more danger from consecutive inflammation, etc., than those traumatisms which have been previously mentioned, because of the following peculiarities: 1. The pathological lesions are more concentrated—resembling in this respect the ecchymoses arising from a concentrated contusion. 2. The lodgment of a ball in the spinal column is very liable to give rise to a septic inflammation, pus formation, dis-

¹² *Railway Injuries*, page 21. Philadelphia: P. Blakiston, Son & Co. 1891.

eased condition of bone, extension of the inflammatory products to the spinal membranes, and even the cord itself. It must be universally admitted that gunshot wounds, fractures and dislocations involving the spinal column, are very serious traumatisms, frequently producing death immediately, or within a few hours; even when this result does not follow, the danger is very great from the consecutive sequelæ.

Let us now take up the consideration of the second query: "Do inflammatory and other morbid changes ever arise from traumatic injuries which are entirely unaccompanied by immediate symptoms?" The conclusions reached by a careful analysis of the above question, must depend, to some extent, on the interpretation which we give to this query. The fact must be admitted that it is not only possible for a patient to receive, under certain circumstances, severe traumatic injuries, of which he remains a longer or shorter period wholly unconscious, and these occurrences are by no means very rare. I can now recall a number of instances of this character occurring to officers and soldiers during the excitement of battle, while I was serving with the army. It also occasionally happens that drunkenness dulls the sensibilities in certain cases to such an extent as to render the patient oblivious to an injury which he may have received, while the same condition will more or less embarrass and sometimes even deceive the surgeon who is attempting to make an examination. These

statements possess only an indirect bearing on the question under consideration. The question relates to the immediate existence of symptoms and not to the observance of the same. A critical examination of this question in the same direction indicated in the above sentences, brings us to the following query: "Are results ever produced without causes?" *i. e.*, "Do inflammatory and other morbid changes ever arise from traumatic injuries, which have failed to produce any lesions?" My experimental studies of the lesions of the cerebro spinal axis have clearly demonstrated the fact, that pathological changes are occasionally produced in this centre, some of which were even apparent to the unaided eye, while others required the aid of the microscope; but which were not followed by any symptom indicative of these lesions during the life of the animal. The question will now be naturally asked with reference to these cases: Would they not have developed inflammatory changes at a later period? I have not before me the data which would justify me in positively asserting that this result *was absolutely impossible*; but I can aver that, in all these experiments, one hundred and forty one, there is not *a single* case which *warrants giving an affirmative answer*. Surgical observations and analogous reasoning fully support the results obtained by our experimental research, not only with reference to the brain and spinal cord, but likewise in other organs of the body. Mr. Erichsen says in his recent work

"On Concussion of the Spine:"¹³ "There is a continuous chain of broken ill health, between the time of the occurrence of the accident and the development of the more serious symptoms. It is this that enables the surgeon to connect the two in the relation of cause and effect. This is not peculiar to railway injuries, but occurs in all cases of progressive paralysis after spinal concussion." It would appear from this quotation that Mr. Erichsen fully concurs with us in the opinion, that the production of a traumatic pathological lesion is always indicated by immediate symptoms, when the degree of injury has been sufficient to entitle it to our consideration. Observation has taught us that the existence of a pathological lesion affords insufficient proof that this injury will be followed by inflammation or other morbid changes. In fact, every surgeon can recall to mind cases of severe traumatic injuries of the brain in which there were extensive lacerations or contusion of this organ; but in which the secondary changes were entirely absent or very slight.

The same remark may also be made in regard to gross injuries in other parts, since the same general physiological and pathological principles prevail in the cerebro-spinal axis as in the other organs of the body. It is therefore entirely proper to introduce in connection with discussions of injuries of the cerebro-spinal axis, in

¹³ A new and Revised Edition. London: Longmans, Green & Co., 1882, page 158.

many cases, analogous reasoning drawn from studies and observations made in other parts of the body. It must be admitted, as a general rule in surgery, that the more extensive and the more destructive the primary traumatism, the greater will be the danger from secondary disorganizing processes. Does it not, therefore, seem absurd to attribute to a single punctate hæmorrhage, or even a half dozen of these little pathological lesions, the power of exciting a disorganizing process in a *healthy spinal cord* which may ultimately produce the death of the patient? Is there a single well authenticated case in which such a result has followed from such a cause?

Let us now proceed to the consideration of our third question, which has a very important bearing on medico-legal cases and likewise on the diagnosis and treatment of myelitis arising from syphilitic disease. Mr. Erichsen says:¹⁴ "It would appear that surgeons and writers on diseases of the nervous system have included four distinct pathological conditions under this one term, 'concussion of the spine,' viz.: 1. A jar or shake of the cord, disordering, to a greater or less degree, its functions without any lesion perceptible to the unaided eye. 2. Compression of the cord slowly produced by the extravasation of blood. 3. Compression of the cord by inflammatory exudations, serum, lymph, or pus within the spinal canal; and 4, chronic alterations of

¹⁴ On Concussion of the Spine, p. 16. London: Longmans, Green & Co., 1882.

the structure of the cord itself as the result of impairment of nutrition consequent on the occurrence of one or other of the preceding pathological states, but chiefly on the third."

We have already paid our respects in full to those subjects included under the headings 1 and 2, but we have yet to deal with those embraced under headings 3 and 4.

There exists no reason to doubt that inflammation, having its origin in the spinal cord or its membranes, may be either acute or sub-acute, or that the former need be developed at an earlier day than the latter. The important question before us for our consideration, however, is how soon do traumatic inflammations arise after the receipt of the traumatism? This question can not be definitely answered—the answer must necessarily be a mere approximation. Nevertheless, I think that observation and experimentation fully justify the statement that traumatic inflammation commonly makes its appearance within four days after the receipt of the injury. In support of the above I will here present a series of experiments, which consisted in fracturing the right leg of twenty rabbits:¹⁵ "This was done without producing a single compound fracture. The temperature details were as follows: Average temperature before the fracture, 102.6°; average temperature two hours afterwards, 102.6°; subsequent daily average temperature, first,

¹⁵ Amputations and their Complications, p. 525. By B. A. Watson, M.D. Philadelphia: P. Blakiston, Son & Co., 1885.

102.6°; second, 102.6°; third, 103.1°; fourth, 103.1°; sixth, 103°; eighth, 103.1°; tenth, 102.8°; twelfth, 103°; fifteenth, 102.8°; seventeenth, 103.2°; nineteenth, 103°; twenty-second, 103°."

In the case of the brain and spinal cord, when there is no open wound communication with these organs, the danger of inflammatory action is greatly diminished. Furthermore, the trivial character of lesions produced by concussion, *and also the exceeding rarity of this traumatism*—except when it is produced by lightning strokes, electric shocks or gunshot wounds—all combine to impress me with grave doubts in regard to its being followed by inflammation. In fact, *there is not sufficient proof to justify the conclusion* that any case of traumatic myelitis, or meningo-myelitis, has ever had its origin from molecular disturbances or any pathological lesion which was invisible to the unaided eye in an otherwise healthy spinal cord or its membranes.

Let us now briefly examine the history of concussion, in order that we may, if possible, discover how these troublesome errors were engrafted on the profession. The history of concussion dates from 1705, when M. Littre published his famous observations. A prisoner struck his bowed head against the wall of his cell and fell dead. The inspection of the head failed to reveal a contusion, tumor or wound in the scalp, or a fracture of the skull. The cranium was opened, when it was discovered that the

brain did not nearly fill the interior of the skull, while the entire brain substance seemed harder to the touch—more compact than usual. This observation has been reported hundreds of times, and it was long claimed that it demonstrated the fact that a violent shaking of the substance of the brain was capable of producing death without any appreciable lesion. Permit me here to call attention to the fact that in the report before me there is no evidence to show that there was any post-mortem examination made of any portion of the spinal column, spinal cord or its membranes, or other portion of the body, except the head. The autopsy of the head, viewed in the light of modern science, is entirely worthless, while the position in which the head was placed at the moment the injury was inflicted suggests the possibility of a fracture or dislocation in some portion of the cervical region of the spine. It may be well to call attention to the fact that in this case, and all the other cases of concussion reported prior to the middle of the present century, the microscope was not employed to aid in the discovery of the pathological lesions. Post-mortem examinations were very rarely made even in cases of concussion of the brain, and, consequently, the case reported by M. Littré was accepted as a typical one. M. Littré, at the time he reported this case of so-called concussion of the brain, had become famous in the medical profession and therefore the following may be very properly applied to him: "Great errors seldom

originate but with men of great minds.”—Petrarch. Mr. Erichsen, in writing on concussion of the spine, in 1875, remarks:¹⁶ “There is little opportunity, reason, or excuse for a post-mortem examination of that structure, which is probably the one that is least frequently examined in the dead house, viz, the spinal cord, as it is the one the correct pathological investigation of which is attended by more difficulties than that of any other organ of the body. . . . So rare are post-mortem examinations of these cases that no instance has occurred to me in hospital or in private practice in which I could obtain one, and with one exception, I can find no record in the transactions of societies or in the periodical literature of the day of any such instance. The only case, indeed, on record with which I am acquainted, in which a post-mortem examination has been made of the spinal cord of a person who had actually died from the remote effects of concussion of the spine from a railway collision, is one that was published in the ‘Transactions of the Pathological Society,’ by Dr. Lockhart Clark. He had been in a railway collision, and without any sign of external injury, fracture, dislocation, wound, or bruise, began to manifest the usual nervous symptoms. He gradually became partially paralyzed in the lower extremities, and died three years and a half after the accident.” There is no reason to believe

¹⁶ Concussion of the Spine, Nervous Shock, etc., p. 177 et seq. New York: Wm. Wood & Co., 1875.

that this man died from even the remote effects of the traumatism. The history of this case entirely fails to connect the disease from which the patient died with the railway collision. Therefore it may be properly said of those who base an argument on this and all similar cases:

"When people once are in the wrong,
Each line they add is much too long;
Who fastest walks, but walks astray,
Is only farthest from his way."

—*Prior.*

TRAUMATISM OF THE CHEST.

BY J. MCFADDON GASTON, M.D.,
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In the course of my investigations on thoracic surgery for the *Annual of the Universal Medical Sciences*, I have been strongly impressed with the lack of knowledge in regard to the injuries of the chest. While this subject has been considered somewhat carefully in my two contributions to that work, there are many practical details of great importance which are not touched upon, owing to the paucity of data afforded by the very limited reports in this branch of surgical experience.

It is not my purpose now to enter into the minute distinctions of the lesions resulting from violence to the walls and contained viscera of the chest. I ask for the attention of surgeons to the great advantage of methodic treatment of traumatism of the chest.

All those inflammatory processes of a latent or idiopathic nature, which lead to serous effusions

primarily or to suppuration secondarily, within the thoracic cavity, are excluded, as not germane to our present undertaking. In like manner, the very extensive lesions involved in operations for the relief of the above conditions in all stages do not come within the scope of this paper.

Foreign bodies entering through the trachea into the bronchi, and causing mechanical obstruction or inflammatory complications, call for consideration, from the general inflammatory impression transmitted to the pulmonary structure.

Blows upon the parietes of the thorax which propagate a shock to the lungs or heart, involving an impairment of function, or subsequent organic changes, come appropriately under the heading of traumatism, though no superficial contused wound is apparent.

Of course, all violence from without which produces injury to the structures within the chest, should be regarded as the proximate cause of the lesion, whether it be hæmorrhage, congestion or inflammation.

The grosser accompaniments or consequences of violence, consisting in notable contusion of the soft parts and fracture of the bony walls of the chest, are frequently the exciting causes of transmitted inflammation to the vital structures of the thorax.

Among the gravest injuries to the chest are the wounds by firearms and by cutting or puncturing instruments. These generally bring about the entrance of air into the pleural cavity, and

thus, by pressure upon the corresponding lung, there is serious interference with the respiratory act. Should the pulmonary tissue be involved in the wound, there is likely to occur emphysema from the entrance of air into the areolar tissue of its parenchymatous structure, so as to effectually prevent the alternate expansion and contraction of the bronchial ramifications.

The former condition of pneumothorax may be a result of air escaping from the bronchial tubes when wounded, even when the external incision or puncture may be of a valvular nature which does not admit of the entrance of air from without.

If the external wound is patulous, the ingress and egress of air occurs with each act of expiration and inspiration, inducing the condition of traumatopnoea.

This is a most unpleasant result, and introduces a grave complication in the nature of the case.

There is also most frequently sanguineous extravasation into the pleural cavity from such injuries, and if the lung has not become collapsed from the entrance of air, its function of respiration is impeded, if not obliterated, by the blood pressure.

Should the parenchymatous structure be involved in gun-shot or punctured wounds of the lungs, there may be emphysema to a greater or less extent throughout the cellular tissue of the thorax and adjacent parts.

The constitutional or systemic effects of any violence to the thorax depends upon the amount of shock in the first instance, or the inflammatory process which is developed subsequently.

The greatest diligence on the part of the surgeon is requisite to avert the immediate fatal result of penetrating chest wounds. Apart from the general manifestations of chest wounds, there are local effects from mechanical causes which require our consideration.

One of the most serious consequences of violence to the walls of the thorax is rupture of the lungs. A fall upon some solid body or the pressure of some heavy weight, while the lungs are greatly distended by closure of the glottis, induces rupture of the pulmonary tissue, with all the serious results of pneumothorax and hæmoptisis. This may occur even without an abrasion upon the surface of the chest; and the history of such an accident is the only explanation of the grave condition within the thorax.

A forcible impression upon the walls of the chest may fracture the sternum or ribs and drive either inwards so as to lacerate the lungs or the heart, leading to immediate or remote serious effects.

One of the grave consequences of an opening through the chest walls is the protrusion of a portion of the lung, constituting a hernia. If this should occur under the observation of a surgeon, he would find little difficulty in returning it and retaining it within by a compress. But

most frequently it has been exposed for some hours and has become engorged, so that it is entirely impracticable to reduce it without enlarging the opening in the walls of the chest. This would seem the most feasible mode of relief if the vitality of the tissue had not been impaired by the constriction. But it is generally held to be safest either to allow the protrusion to remain and slough away, or to assist its detachment by placing an elastic ligature around the neck of the hernial tumor. The edges thus become agglutinated and the lung occluded. There may also occur laceration of the lesser or greater blood vessels of the thorax calling for prompt relief, if the injury does not prove immediately fatal.

It has been proven by subsequent observation of the effects that lesions of the heart have healed and that injury to the coats of the large arteries are not necessarily fatal. But there is no instance on record of a wound of the vena cava without a fatal result.

The thoracic duct, in like manner, cannot be wounded with impunity, and the escape of the lymph terminates in death.

While the ligation of the intercostal arteries, the internal mammary and the subclavian is attended with difficulty, the hæmorrhage from these vessels may be controlled, and the patient should not be abandoned to his fate. If blood has accumulated within, it may be withdrawn by suction, or its escape may be promoted by position.

Those who have had the largest sphere of observation in this branch of thoracic surgery will best understand the uncertainty hanging over pulmonary disorders resulting from violence.

Commencing with the doubts as to the production of traumatic pneumonia, and running through the abscesses of the parenchymatous structure of the lungs, it is remarkable how little is finally and definitely determined as a guide for practice in thoracic injuries. It will be found upon attempting to analyze the reports of such lesions that quite a variety of opinions are entertained by different observers, and that really no methodic treatment has been adopted generally by the medical profession. I know of no work on surgery which lays down fixed rules for the practitioner in the management of wounds of the chest.

The contributions to the literature of traumatism of the chest in Holmes' System of Surgery, Vol. I, in the International Encyclopædia of Surgery, Vol. II, in the Reference Hand-book of Medical Sciences, Vol. IV, and in the Annual of the Universal Medical Sciences for the years 1889, 1890 and 1891, represent fairly the status of this branch of surgery. Those who seek to keep abreast of the recognized data may learn from these works what has been accomplished for the relief of this class of injuries. It will be noted that there are conflicting views in regard to the proper treatment of some of the conse-

quences of penetrating wounds of the chest, dependent, no doubt, to a great extent, upon the different standpoints from which observations are made. While there is a correspondence, for the most part, among different authorities in the propriety of closing the external opening in the wall of the chest, when the amount of blood in the pleural cavity is small, contradictory opinions are expressed when it is large.

To define more clearly the attitude of those who have written upon this topic, I may state that individual views of the nature of such injuries, with the steps recommended for their relief, rest very much upon personal observation, and not upon the consensus of general experience by the profession.

There are articles upon thoracic wounds in most of our standard works on surgery, presenting many points of a practical bearing, as viewed by the author, yet with such material differences in their application, under the emergency of treatment, as to avail little for the practitioner.

While we should not overlook the writings of former days, it may be stated that little progress has been made in the elucidation of wounds of the chest since the works of Gross and Agnew were presented, and some of the more recent authors, as Wyeth and Roberts, have touched upon chest injuries very briefly, while Senn ignores, with a few exceptions, traumatic developments of the thorax, in his principles of surgery.

Many important data, illustrating the results

of gunshot wounds of the chest, are given in the Surgical History of the War, published by the United States Government, and the statistics of non-penetrating and penetrating wounds of the chest therein presented, demonstrates the gravity of the latter as compared with the former in a most conclusive manner. This, however, only confirms the results of the records of military operations throughout the world, showing that about 1 per cent. of non-penetrating wounds of the chest prove fatal, while over 65 per cent. of penetrating wounds terminate in death at an early period after the injury.

One of the practical questions of greatest moment, in regard to the hermetically sealing of gunshot wounds of the thorax, remains unsettled.

Experiments upon the inferior animals, commencing with those of Houston in 1728, for illustrating the effects of punctures and incisions into the thoracic cavity, have been attended with such different results upon the lungs, that it is yet undetermined whether collapse ensues directly from the wounds. There is such an intimate relation of the surface of the lungs to the costal pleura, that something must separate them for the occurrence of pneumothorax, and hence it occurs that openings are not always followed by this result.

It is held that the falling away of the lung is not a uniform consequence of a penetrating wound of the chest. If the wound is small, or if it is at a distance from the free margin of either lobe, the

expanded lung remains in contact with the costal pleura.

The adhesion of the two pleural surfaces is illustrated by an experiment of Surgeon A. H. Smith, in which, in a recently killed animal, an opening was made in an intercostal space midway between the sternum and the spine. The lung did not collapse; but on making another in the same intercostal space, close to the sternum, the outer surface of the lung was observed to slide backwards, though still remaining in contact with the chest walls, until the edge of the lobe came opposite the first opening. Then for the first time air entered here, and the pneumothorax became complete.

Gordon and McDonald found that with small tubes introduced into the chest, the breathing became quick and laborious, while the lungs had fallen away from the chest walls for an inch. After four minutes, they enlarged the wound and put in tubes whose united calibre was twice that of the glottis. The respiration became very laborious. On closing the wound, however, and applying friction to the chest, the respiration was restored, and in ten minutes the animal was able to walk about. It was killed on the fifth day and nothing notable was found in the chest.

Dr. Northrup reports some experiments on animals, contradicting the statements of Samuel West, that the force of cohesion sufficed to maintain the lung in complete expansion when the parietal pleura was punctured.

Further experiments were made, in which a dog's two pleuræ were fitted with double flanged canulæ, stoppered with corks. Until the dog recovered from ether, the two corks were left in place. When fully recovered one cork was withdrawn, and the dog scarcely suffered dyspnœa on moderate exercise. When both corks were removed the dog traveled about for two minutes and succumbed to severe dyspnœa, which again entirely disappeared on replacing the corks.

These results throw some light upon the practical resort to closure of the external openings into the pleural cavity as a curative measure in cases of penetrating wounds of the chest.

Howard's proposition to the Surgeon General of the United States during the war, to test the process of hermetically sealing the external orifices of gunshot wounds of the chest, met with so much prejudice on the part of the surgeons of the Federal Army, that it was used in a limited number of cases. It is also inferred that the conditions under which this measure was tried were not favorable to its success, as the most grave cases were the subjects. Judging from my own experience of the good effects of closing penetrating wounds of the chest, and from the records of cases thus treated by others, it seems unfortunate that hermetically sealing was not applied on a larger scale, so as to afford the statistics for a final and conclusive decision as to its merits. Independent of the recognized advantages of closure in the lesser accumulations of blood in the

pleural cavity, it is held by some, with a show of practical discernment, that in the most extreme cases of thoracic hæmorrhage, the flow of blood externally should be arrested by plugging the orifice, so as to favor the coagulation of the blood within, and by compression upon the lung to prevent further extravasation.

If this course is applicable in the most aggravated condition of penetrating wounds of the chest, as well as to the simpler form in which there is a slight hæmorrhage into the pleural cavity, why may it not prove serviceable in the intermediate accumulations of blood in the thorax, and thus be applicable to every variety of penetrating wounds of the chest.

It is not expected that a general rule can be laid down, without exceptions, for the immediate and complete closure of all penetrating wounds of the chest. There must be certain preliminaries observed in the preparation of the patient for receiving the benefits of such proceeding, so as to close the orifice with the least blood in the cavity of the pleura, that is possible. Placing the patient so that the opening shall be the most dependent part, with a firm bandage around the thorax, and making the occlusion immediately after the expulsion of air and blood from the wound by forcible inspiration, should promote a favorable result.

If the case is complicated with emphysema involving any considerable portion of the surface, plugging the orifice with a condom stuffed with

sponges, as has been suggested for the arrest of hæmorrhage from an intercostal artery, will prove efficient in preventing the escape of air into the cellular tissue and at the same time accomplish complete occlusion of the thoracic cavity.

A comparison of this procedure may be made with that in which the air enters the cavity of the pleura and induces collapse of the lung, thus arresting the flow of blood from the wounded parenchyma, with a tube in the opening, as recommended by Packard, for prevention of emphysema. In this latter, the air pressure is supposed to arrest the bleeding. In the other condition, blood clot presses upon the lung so as to control the hæmorrhage.

The variable influence of the air in the pleura, with more or less air entering the lung by the inspiratory act of the sound side, renders this recourse very doubtful in permanently controlling the escape of blood from a wound of the lung.

On the contrary, the formation of blood clot within the pleura keeps up a pressure which can be relied on to prevent the further bleeding from the pulmonary lesion.

All those who have observed the relief of distressing dyspnœa by closing an open wound of the chest, concur in its great benefits.

It may be inferred from the favorable progress of cases in which a large accumulation of blood has remained in the pleural cavity, that its gradual absorption occurs. If the air is completely shut off from without, of course germs cannot

enter to set up decomposition in the mass, even should there be a perforation of the bronchia, as it is held that air passing through this seive-like structure is rendered innocuous.

With the larger death-rate from penetrating wounds of the chest treated without special reference to the process of occlusion, the result is not likely to be more serious from a uniform adoption of sealing hermetically all external openings of penetrating wounds of the thorax.

If the worst consequence of this procedure ensues in purulent development, there is open to the surgeon such measures of relief as have been adopted successfully in empyema from other inflammatory processes.

In this connection, a few cases which have come under my observation, may serve to illustrate the open and closed methods of treating wounds involving the thoracic cavity.

Many instances of gunshot wounds of the chest were brought to my attention as chief Surgeon of Division, during the civil war in this country. But I had no opportunity of following up the subsequent course of those injuries; and would refer to reports of such cases in the Surgical History of the war for the results. I will give, however, an outline of some characteristic cases, occurring in my own private practice and in consultation with others, during the past few years.

One case had a pistol ball wound at short range between the fourth and fifth ribs, on the right side, in front, and ranging downward. All

the physical signs were present, indicative of a wound of the right lung, extravasation of blood into the pleural cavity. It was kept open for a time, but closed afterwards spontaneously and terminated fatally.

Another case, in which a ball from a large Colt's revolver traversed the left side of the chest, entering through the lower border of the pectoral muscle and escaping between the ninth and tenth ribs near their cartilages, involved the pleural cavity. There was a discharge of frothy blood from the posterior wound and the physical signs of extensive sanguineous extravasation into the left pleural cavity. The heart was perceptibly pressed over to the right, carrying the apex beyond the median line. While no suture was used to close the wounds, they were hermetically sealed by antiseptic dressings, and notwithstanding considerable constitutional disturbance, subsequently the patient made a good recovery.

A third case was a child, accidentally shot, the pistol ball entering through the ensiform cartilage and ranging upwards. No precaution was used to close the wound, and the patient died from empyema.

The fourth case was from a pistol shot which entered just below the ensiform cartilage, ranging upwards to the right and lodging above the eighth rib, thus passing through the diaphragm and lower portion of right pleural cavity. The external hæmorrhage was not pronounced, but the presence of blood in the chest was inferred

from the physical signs of dulness upon percussion, and diminution of the respiratory murmur under auscultation. There seemed to be no indication for occlusion of the external wound, and it was therefore left open. As there may have existed complications involving the abdominal viscera, the fatal termination on the fourth day cannot throw any light upon the true cause of death.

The fifth case affords an instance of a pistol ball entering the chest, immediately over the heart, traversing the mediastinum and lodging upon the sixth rib of the right side just behind the posterior axillary line. The external wound was occluded, and the ball was not removed until after the general shock and slight inflammatory reaction had passed off. The patient made a good recovery by the strict observance of masterly inactivity.

This case, with that preceding, having the ball lodged superficially for several days before removal, seems to emphasize the caution against cutting down and extracting a ball under such circumstances at the outset.

I recall in this connection, after the first Manassas battle, allowing a minnie ball, which was impacted in the clavicle and first rib, to remain, lest by its extraction the chest cavity should be exposed; but the final result of the case is not known.

The practice of removing balls lodged between ribs, which is inculcated in Agnew's Surgery, without proper limitation, is more honored in the

breach than by the observance. It is evident that the immediate extraction of a ball from the border of a rib, after it has traversed the chest, must leave an opening into the cavity of the pleura and aggravate the gravity of the case.

A counter opening in the muscular structures for the removal of a ball which is near the surface, does not in the experience of surgeons of large practice, retard the healing process along the line traversed by the ball.

But with the conditions presented in a gunshot wound in the thorax, when an opening already has been made by the entrance of the ball, it is not good surgery to make another for the extraction, until the wall behind has become solidified.

In illustration of the effects of punctured and incised wounds of the chest, a few examples of knife stabs, which have occurred in my practice, will be added.

A case of stabbing, between the fourth and fifth ribs, in front of the anterior axillary line on the left side, was accompanied with localized emphysema. While there was evidence of sanguineous effusion in the pleural cavity, the bleeding was profuse externally.

There was slight dyspnoea upon lying down, which was relieved in the sitting posture. The wound was closed by adhesive plaster with a compress and bandage, and the patient recovered without an untoward symptom.

It has not been found necessary to use stitches in these wounds inflicted by the thrust of a knife

blade, as the coaptation is effected by the above process, so as to hermetically close the opening in the chest.

In another case a stab was inflicted between the sixth and seventh ribs on the left side near the margin of the scapula, from which blood and air escaped at each inspiration, with considerable accumulation of blood in the pleura, and hæmoptysis. The external wound was closed immediately after a gush of blood and air from the opening. The patient became more quiet afterwards. This case was accompanied with traumatic pneumonia and marked constitutional disturbance, but ultimately recovered.

A third case came under my observation in which a knife blade entered between the fifth and sixth ribs on the right side, penetrating the lungs and attended with the accumulation of blood in the pleural cavity. There was no very marked dyspnoea, and as the flow of blood externally gradually diminished with the dependent position of the wound, it was not thought that closure of the opening was indicated. Inflammatory symptoms soon developed with subsequent adhesion of the pulmonary and parietal pleura. In the end, suppuration of the lung found its way though the external opening. A weak solution of carbolic acid was injected into the suppurating tract daily, and the healing process progressed favorably, so that there remained eventually but slight impairment of the lung from the injury.

The inference from these cases goes to prove that suppuration is more likely to occur when the incised wound is left open than when it is closed immediately and kept occluded.

A fourth case was seen some days after a stab had been inflicted between the seventh and eighth ribs, and there was a protrusion of a small globular mass of pulmonary tissue from the wound. As it had occurred shortly after the injury and was tightly constricted by the margins of the wound in the thoracic wall, the neck of the hernial tumor was encircled with an elastic ligature, as most likely to effect a prompt and safe detachment of the mass. In a few days it separated, and there was no further trouble with the case. If there was any escape of blood into the pleura it was most effectually shut in by the plugging of the opening, and afforded an illustration of the favorable issue of hermetical sealing in penetrating wounds of the thoracic walls.

ON APPENDICITIS AND PERICÆCAL
INFLAMMATION. WITH NOTES OF
CASES ILLUSTRATING UN-
USUAL DIFFICULTIES IN
DIAGNOSIS.

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No subject within the domain of abdominal surgery within recent years, has made such decided progress, or is at the present time, attracting more attention than that of operation for intestinal lesions, whether due to traumatism or disease.

The fact that perforation so frequently complicates perityphlitis, brings the question of the management of such cases prominently before us as surgeons, and requires that we should not only entertain decided convictions as regards the pathology of the affection, but also have well matured opinions as to the details of operating, and upon the time when such operation should be performed with the least risk to the patient, and with the prospect of the most successful result.

PART I.—ANATOMY, PATHOLOGY, AND DIAGNOSIS.

Appendicitis, simple or perforating, with resulting perityphlitic inflammation, or pericæcal abscess, is a comparatively common pathological accident ; and its diagnosis and treatment belong both to medicine proper and to surgery. Almost invariably the case is first seen by a physician, and, as the records will prove, very much depends upon his ability to promptly diagnose the morbid condition, and to appreciate the importance, in certain cases, of early surgical operation for its relief, and on the other hand, the gravity of the responsibility assumed in delaying operative procedure until the patient is in a dying condition, or fast approaching it. Upon the physician also usually devolves the duty of acquainting the family of the patient, or the patient himself, of the peril he is in, and of convincing them that delay is indeed dangerous when an abscess has formed adjacent to the appendix vermiformis, and peritonitis is threatening or is actually in progress. The surgeon is interested especially in the diagnosis and details of operation, and in any special dangers or difficulties attending it.

I have thought therefore that this would be an appropriate topic to bring before this section for discussion. Moreover, this subject is attracting a great deal of attention at the present time ; so much so, indeed, that the American Surgical Association, and other societies have repeatedly

had it up for consideration within the last few years, and it has more than once received contributions from our own proceedings. At its meeting in December, 1887, three papers were read before the County Medical Society of Philadelphia: One on the "Pathology of Pericæcal Inflammation," by Dr. John H. Musser; one upon "Diagnosis," by Dr. William Pepper; and one upon "Treatment," by myself, by invitation of the society. In my communication, the indications for the operation, its technique, and details of after-treatment, were clearly indicated. I may say now, more than three years later, that subsequent events have not lead me to abandon, but rather to confirm, the views then expressed as to diagnosis and treatment. I then presented a case which had been operated upon by me in the spring of 1887, in the manner prescribed in that paper, which made an excellent recovery after removal of an ulcerated and perforated appendix. I have reported a number of others since that time, showing the importance of early diagnosis, prompt operation, exploration of the abscess cavity and removal of the cause of the mischief. The case just referred to, I may say, was the first recovery on record, so far as I am aware, where the radical operation of amputation of the appendix was deliberately undertaken for the relief of pericæcal abscess. This alone is sufficient to show how recently the subject has claimed the attention of the profession.

This operation just referred to, has already

become one of the established procedures of surgery. It is somewhat surprising, therefore, to learn that some surgeons still use the aspirating needle in the diagnosis of abscess, and do not consider it of vital importance even to remove the appendix in the treatment. And yet this is what a western surgeon reports that he witnessed when on a recent visit to the Metropolis (*American Practitioner and News*, Louisville, Ky., Vol. x, page 380).

This, to say the least, betrays a deplorable want of agreement among surgeons and teachers of surgery as regards one of the most vital questions of operative treatment, and even the means of diagnosis.

I think that the present state of abdominal surgery will support me in stating that, as a rule, in any abscess of the ileo-cæcal region, appendix disease should be suspected, and in such case the organ should always be sought for, in order to ascertain its condition; unless this is done the very first principles of correct treatment are violated. If a diseased appendix be permitted to remain it is liable to set up further mischief. In such a case, as the rule, the future welfare of the patient demands that it should be excised, unquestionably so if inflamed, perforated, or containing foreign bodies.

It seems surely as if enough had been said, with regard to the dangers of using the exploring needle, of its utter unreliability, and of its inability to afford information of any value in

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these cases, to cause its complete abandonment, especially by surgeons who occupy important and responsible positions as teachers and operators, and who aim to serve as guides for others.

A brief review of the pathology of appendicitis, I think, will make it clear to us all, that the life of the patient often depends upon the ability of the medical attendant to promptly recognize the cause of the disease, and to early institute the proper measures for its relief and very often its removal, as the only way to afford relief and permanent safety to the sufferer.

In taking up the systematic discussion of this subject it is perhaps better to very briefly recall the anatomical relations of this part of the body, and the position of the appendix in health and disease.

Anatomy.—From a number of dissections of bodies where death has been produced by disease not affecting this locality, made by me and under my direction at the Pennsylvania Hospital, and elsewhere, I can supplement the very meagre and often incorrect notices of the anatomy of the appendix usually contained in our text-books. In the first place the opening into the appendix from the cæcum is not patulous, as it is represented ordinarily; this opening is also occluded by any abrupt change of direction of the process by which it often becomes parallel with the bowel. This places a valvular fold of mucous membrane directly over the opening which usually closes it as effectually as the foramen ovale

is closed in the heart during the first few days after birth. Moreover, it is stated by good authority that the calibre of the appendix internally is about the size of a goose quill. I question very much the accuracy of this statement in any case, as I have never found it to be anything approaching this size in health; and rarely, if ever, is it distended throughout its course, by secretion to such an extent as this; ordinarily there is no cavity at all, as the walls are collapsed, and I have found that a good sized probe was as much as could freely pass through the canal.

The opening into the appendix is visible upon the inner (left) side of the lower and posterior extremity of the cæcum; it is covered with the folds of mucous membrane and occluded by mucus under ordinary conditions. Were this not the case, and the opening patulous, as is so frequently figured (especially if the calibre were as large as some have represented), appendicitis would be a far more common affection than it is; and, indeed, few children would live to attain the age of adult existence. In length, the appendix varies from two to five, or even nine inches, as I found it in one case. It varies in normal position and direction; so that it can scarcely be said to have normal position; most frequently it is found upon the posterior and inner (or left) side of the cæcum and ascending colon, extending upward towards the liver or gall bladder, to which it may be adherent. The free extremity often points toward the spleen, but it may fall down into the

pelvis, and become adherent to the broad ligament or right ovary, or it may become twisted around the small intestines, forming a loop which may cause obstruction or strangulation of the bowel, or finally it may become part of an inguinal or scrotal hernia. At its base the appendix joins the cæcum, obliquely, on the posterior and inner side, just below and on the same side as the ileo cæcal valve, but not at the lowest portion of the cæcum. The summit of the appendix or free extremity is rounded and imperforate. Upon splitting it open, longitudinally, you notice the comparatively great thickness of the walls, both the mucous coat and submucosa being well represented. The glands in the mucous membrane secrete a small amount of mucus, which, with the epithelial débris, is gradually discharged into the cæcum. Should the opening into the cæcum become impervious from any cause, these secretions may gradually accumulate and become inspissated, forming casts or round balls, resembling cherry stones, but consisting of sandy and organic matter. Such secretions are very common.¹ The follicles of Lieberkuhn are numerous in the appendix, and the agminated Peyerian glands are also well developed near the summit of the tube, according to the late Prof. Henry H.

¹ In 13 consecutive post-mortems made by me in persons who died from other causes than intestinal disease, the appendix in every instance but one contained fecal concretions. In a number, the foreign bodies were quite soft, others were firm, some gritty, yellow or brown in color. The canal of the appendix in several was blocked for an inch or more by a series of such fecal masses, which resembled mice dung. Such material imprisoned may readily excite irritation, inflammation, ulceration and finally perforation and abscess.

Smith, who was also inclined to think that a gland or two of Brunner might also be present. In the lower animals, especially among the rodentia, the appendix is much larger than in man and is so richly endowed with glands as to fulfil an important purpose in digestion. The canal of the appendix is also relatively, much larger in the infant than in the adult.² In the newly born infant the appendix frequently contains meconium.

Dr. Formad, Coroner's Physician and Pathologist in the Philadelphia Hospital, confirms the above observation with regard to the presence of glands in the appendix, and states that he had frequently met with typhoid and tubercular ulcerations and catarrhal changes in the vermiform appendix as a part of a general disease of the mucous membranes of either the large or small intestines. He also has found "Fecal matter and concretions exceedingly common in the vermiform appendix, surely much more common than is generally held."³ Authentic cases have been recorded by Morgani, John Hunter, Meckel, Haller and others, where the appendix was wanting in otherwise normal individuals. I think that as regards its functions nothing need be said.

² Prof. Leidy, under date of February 27, 1891, in a note to me says: "I have observed the appendix varying from about three to nearly six inches in length, but have never seen such a case in which it was absent. In the infant it appears to be less abruptly an extension of the cæcum, that is to say, from the subsequent greater proportionate enlargement of the latter, the appendix becomes a more abrupt extension."

³ Dr. Toft of Copenhagen, who, while prosecutor to the Royal Frederiks Hospital, found residua of appendicitis in the form of adhesions in 35 per cent. of all post-mortem examinations made.

Whatever relation it may have to the act of digestion in some of the lower animals, in man it is merely a rudimentary organ, having no function, since it may be naturally absent without affecting the health of the individual, and after its removal by operation, the patient has perfect digestion and suffers no inconvenience from its loss. Speaking from a surgical standpoint, it would seem that the principle function of the appendix is to get inflamed and cause peri-typhlitic abscess.

PATHOLOGY.

The chief interest in the pathology of appendicitis lies in the relation existing between disease of the appendix and pericæcal inflammation and abscess; a relation which, in many cases, is very intimate and easily demonstrated. Pathologically as well as anatomically, the appendix is part of the cæcum; its structures are continuous, and inflammation or other morbid process may extend from one to the other, and yet as a matter of experience, it is generally found that the appendix may be the seat of inflammation, even perforation or gangrene, while the cæcum remains unaffected, or at the most is only affected secondarily. As to the cause of appendicitis, it appears to be always traumatic, or at least the inflammation and ulceration is due to the presence of retained secretions, or of a concretion which acts as a foreign body, oftentimes the inflammation being excited by a blow or unusual physical effort. I repeat that irritation. inflam-

mation, and perforation of the appendix is most frequently, if not invariably, caused by the presence of foreign bodies in the canal of the organ. Such substances are usually phosphatic, or fecal concretions or small objects aggregated which have gained entrance, or the ordinary secretions of the canal may be condensed into concretions made up of epithelial or other constituents. The retention of such material may be caused by stenosis of the cæcal opening, or by thickening of the mucous coat, or by any abrupt change in the position of the appendix which occurs when the organ becomes adherent to the cæcum, so that the outlet of the organ becomes more or less blocked. While it is popularly believed that such concretions are originally foreign bodies, such as grape seeds or cherry pips, this is rarely the case. In the great majority of cases the masses are more or less globular, others are shaped like small date stones, moulded to the interior of the canal, evidently a collection from mucous secretion which deposited phosphate and carbonate of lime upon a nucleus of fæcal origin. As previously intimated, some of the cases are due to occlusion of the canal, and are attributable to retained secretion. Many undoubted cases have been reported, however, in which foreign bodies, such as pins, needles, oyster shell, small seeds, etc., have entered the appendix from the bowel, and caused perforative appendicitis.

In default of a more satisfactory classification of cases of inflammation of the appendix and its

results, I feel justified, after considerable experience, in recognizing three varieties or groups of the affection.

First group:—*Irritation or inflammation*. Cases of simple irritation or inflammation of the appendix during the first attack, cannot be positively recognized, but the recurrence of such an attack, establishes a strong probability of this diagnosis.

Every practitioner is familiar with ordinary appendicitis; the symptoms are quite characteristic; the disease is not infrequent and is generally soon recovered from. Recurring attacks also are very common, the intervals being variable, from a few weeks to several months, or, as in some cases, years may intervene. If the cause has been due to some irritating foreign body, and the organ has been able to discharge its contents into the cæcum, a permanent recovery may result, but such favorable termination rarely occurs. If the disease arose from retained secretions, which have been gotten rid of, atrophy of the appendix may follow on the subsidence of the inflammation and the organ become a cord-like body, no longer liable to internal disturbance. If the appendicitis be due to minute solid bodies, attack after attack is likely to occur, and as these increase in size, the probability of ulceration of the mucous membrane from pressure is likely to increase as time goes on.

Second Group :—*Inflammation, ulceration, or perforation*. Any case of mild appendicitis be-

longing to the first group of cases may pass to the second. As a result of attacks of appendicitis of a more or less severe type, lymph exudation is thrown out, not only about the appendix, but upon and around the neighboring structures. If upon the intestines, such exudation may occasion bowel paralysis, or bands of lymph may involve the intestine subsequently in absolute destruction. So, likewise, lymph may be exuded in sufficient amount in all directions on the peritoneal surfaces, and form a barrier more or less complete, sufficient to protect the general peritoneal cavity from septic contamination, when abscess forms in the pericæcal region. In other cases the exudation forms a distinct abscess wall completely encysting the appendix, and constitutes the distinct tumor, so often observed in such cases; it is usually well defined, immovable, more or less dense, and painful to pressure. Although it may contain pus, as a result of perforation of the appendix, there is no fluctuation until the tumor increases in size; as it approaches the surface, the superimposed tissues become œdematous. Such abscesses may open through the abdominal wall, and so establish a fistula between the bowel, the abscess cavity and the external abdominal surface, or at any other point where the abscess should tend.

This lymph exudation which surrounds the appendix when ulceration and perforation is imminent, may appear very quickly; the results of perforation are thus emptied into the lymph

mass, and are held absolutely encysted. As the pus increases in the interior of the tumor, the exudation of lymph may increase, or the wall of the abscess may become thinner, and so the abscess may burst into the peritoneal cavity, or into the superimposed cellular tissue. The formation of pus due to a perforated appendix is announced by most characteristic symptoms if the pus come in contact with the peritoneum; but when the appendix perforates into a lymph tumor, the peritoneum is guarded, and the symptoms of pus formation are not so marked; indeed there are frequently no symptoms whatever which would indicate such an accident.

Third Group:—*Ulceration and Perforation*, with insufficient lymph protective walls.

Many of the reported cases belong to this class. The symptoms appear suddenly, and present the gravest characters. Now, and then especially in children, the disease advances with intense rapidity, the patient early entering a condition bordering on collapse; such cases I have seen terminate fatally in forty-eight hours, or even less time. Careful inquiry revealed in every case, the fact of a former attack of appendicitis. In such cases when perforation happens, there is either no lymph protection to the peritoneum when the accident occurs, or else the exudation has been insufficient, so that when sloughing or perforation takes place, the contents of the appendix and the sloughing tissue are at once

brought into contact with the general peritoneum. Such cases are early associated with symptoms of unusual depression, and often profound collapse.

DIAGNOSIS.

First Group of Cases: — Pain is usually the earliest and most common symptom of appendicitis. It may come on suddenly or the reverse, be slight, resembling colic, or severe in character; it is usually increased by pressure. There may be nausea and vomiting, and a coated tongue and constipation are commonly present. There is generally some acceleration of pulse, and a slightly elevated temperature. The ileo cæcal region is generally tympanitic. Sooner or later all these symptoms may disappear and convalescence apparently be established. As I have in former papers pointed out, the occurrence of symptoms such as above detailed, especially if there has been a relapse or recurrence, are serious enough to give rise to grave apprehensions for the future, for in a patient with a diseased appendix, a blow, slight local injury, undue exercise, straining, constipation, or even an attack of indigestion, may provoke a recurrence of irritation in the already diseased organ which may lead to inflammation, ulceration, and perforation. Such cases as I have detailed, which do not proceed to ulceration and perforation, are of very common occurrence; under appropriate treatment they go on to apparent recovery. I believe, however, in all cases of pericæcal irritation or inflammation

(or, at least, in by far the great majority of such), the appendix is the source of, and responsible for this condition; the danger is therefore not overcome by the subsidence of the symptoms even if such are ever so mild. The subject of such an attack or attacks, may recover by discharge of the contents of the appendix into the cæcum; or through atrophy of the organ or adhesion to the cæcum with more or less complete obliteration of its calibre. But such a favorable result must be very exceptional, and its occurrence in any given case cannot be depended upon.

Second Group:—Incident to the inflammation, consequent upon repeated attacks of appendicitis, adhesions may take place, which involve not only the adjacent intestine, which may cause more or less obstruction, but as a result of such attacks, lymph exudation takes place, often in large amount, which may completely envelop the appendix.

It is this exudation which forms the tumor in such cases, so that when perforation occurs, the pus does not gain access to the general abdominal cavity, but remains encysted; if this protection did not frequently exist, perforated appendicitis would be a much more fatal affection. This tumor wall is often quite dense and thick; when its contents increase the sac distends proportionately, or if more or less thin, the abscess may open and discharge its contents, either into the peritoneal cavity or into the superimposed tis-

sues and reach the surface, or in some cases, by attachment and perforation, be emptied into intestine, bladder, or other organ. Such abscesses are far less serious than those which are found in the third group, where the appendix has no encasing lymph wall. In the former, or second group, although as already stated, pus has formed, it is completely encysted in a tumor, similar to such formations in the ovary or tube, with no special early symptoms necessarily indicating pus formation.

Third Group:—When in addition to the symptoms of appendicitis, those of a far graver nature appear suddenly, viz.; intense local, afterwards general, abdominal pain, marked tympanites, a fluctuating temperature, reaching 102° or even higher, with slight or decided rigors, moderate or profuse sweatings and prostration, there can be no question of the advent of acute perforation and abscess formation in close contiguity to peritoneal surfaces. In such cases where the patient, who has been apparently in perfect health, is suddenly stricken with such grave symptoms, indicating perforation—and I have seen a number of such—careful questioning always reveals the fact that the patient has had one or more attacks of appendicitis, but often so trivial as to be almost forgotten. The history of the former attacks, however slight, therefore, would clear the way for establishing a positive diagnosis.

Although it may be possible for inflammation and abscess to occur quite independent of the ap-

pendix in the pericæcal region, yet such instances must be exceedingly unusual. Several years ago (in 1886), I opened a supposed uncomplicated pericæcal abscess of large size; apparently there was no communication with the appendix or cæcum, the walls of the abscess seemed to involve only the connective tissues. The patient recovered, but subsequently suffered from attacks of pain in the same locality, which were then judged to be from a diseased appendix; suddenly, and nearly two years afterwards, the symptoms of perforative appendicitis and peritonitis appeared; there was no tumor, the ileo-cæcal region being markedly tympanitic; section was promptly made, which discovered an abscess and commencing general peritonitis. The lymph exudation was recent, the original abscess walls had been absorbed, so that there was no protection to the general abdominal cavity. The appendix was found enormously enlarged and perforated; it was excised, and the patient has since married and has continued in perfect health. Had the second abscess not formed, the case would have been judged to be a simple pericæcal abscess. While there is every reason to believe that all acute abscesses in the appendix region are due to some lesion of this organ, there is no special reason for the occurrence of simple typhlitic abscess.

I repeat, that it is very doubtful if those cases of perityphlitic inflammation, which under appropriate treatment, go on to convalescence, are cases of inflammation purely of the walls of the

cæcum, and connective tissue; such a condition possibly may occur, but it is more probable that in every case the irritation arises in the appendix, with more or less a local peritoneal inflammation. Then again, in every case in which I have excised the appendix for perforative inflammation, there has been a history of former attacks, the symptoms of which corresponded with those which some clinicians describe as indicating typhlitis. In order to determine the presence of an abscess cavity in the ileo-cæcal region, if the symptoms detailed would not be considered sufficient, rectal examination might be made, but I have never been in the slightest degree aided by this procedure.

DIFFERENTIAL DIAGNOSIS.

It, probably, is impossible to differentiate disease of the cæcum from appendicitis at an early state of the malady, as their relations are so close and they both give rise to similar local disturbance. Both organs are covered by peritoneum through a variable portion of their extent; both are liable to irritation, inflammation and perforation.

Perforation of the appendix is a very common accident, while the reverse is true with regard to the cæcum. Even in those cases where cæcal perforation has occurred, it is most likely the result of previous appendix perforation or disease.

One such case occurred in Pennsylvania, under the care of Drs. Rich and Sailor Brown, of Will-

iamsport. I saw the patient in consultation. On the second day after the removal of the gangrenous appendix, fæces came from the wound, and upon careful inspection, two gangrenous perforations were found involving the cæcum. At the time of the appendix removal, the cæcum and colon were markedly impacted and discolored; the violent inflammation about the appendix had extended to and involved the intestine. The resulting gangrene was due in part to contiguous inflammation and in part to impaction. But if this abscess cavity had been simply opened and the appendix not reached, the subsequent appearance of fæces would apparently have established the diagnosis of simple cæcal perforation, while the lesion of the appendix would have been overlooked.

The history of previous attacks of pain in any given case would establish the diagnosis between perforative cæcitis and perforative appendicitis in favor of the latter; at any rate, the necessity for operation being the same in both, the final diagnosis can be left until section has been made.

From Acute Intestinal Obstruction.—The symptoms in intestinal obstruction advance very rapidly, even more so than in appendicitis. In volvulus there is usually more severe pain, which is referred to the umbilicus. Intussusception is accompanied by frequent desire to stool and discharges of mucus and blood; an examination by rectum will probably establish the diagnosis, which also can be said of impaction. Finally,

obstruction may be simulated by the attending peritonitis owing to the paralyzing effect on the bowels.

Strangulation of the bowels, intussusception, peritonitis, volvulus, generally come on very suddenly. Impaction of fæces, psoas or iliac abscesses or tumors, come on gradually. Cæcitis and perforative ulcer of the cæcum are also more or less rapid in their course, and point superficially more quickly than does the abscess to which appendicitis gives rise.

From Spinal or Perinephritic Abscess:—Attention to the history of the case and to the local signs of the disorder will enable us to diagnosticate these forms of abscess. The treatment being almost identical, at least as far as laparotomy is concerned, we need not waste time in making refinements of diagnosis, although the differential diagnosis can generally be made.

In psoas abscess difficulty may be experienced at times in differentiating it from pericæcal inflammation. But in the former there is generally dorsal pain and gastric irritation, and a history of long continued ill-health. Abscess from Potts' disease generally points to the groin, either just above or below Poupart's ligament. It also is associated with ill-health and difficulty in walking. In abscess of the right ovary and tube, the history and digital examination of the case would usually establish the diagnosis. An abnormal pouch or diverticulum of the ilium occasionally is found in the right iliac region, and might

complicate the diagnosis, which could only be cleared up after section.

Tumors, both malignant and non-malignant, may be found in this region, but as a rule little difficulty need be experienced in clearing up any doubt. Their physical characters and clinical history are usually sufficient.

When pericæcal abscess points in an anomalous situation, all available diagnostic skill will be required to affect a diagnosis. Unlooked-for complications also may arise, which the surgeon must expect, and which he must always be prepared for. Some of the difficulties which occasionally confront us in making a diagnosis are well illustrated in the following cases :

APPENDICITIS; LATERAL SECTION; OPERATION
COMPLICATED BY AN ENLARGED, ELONGATED
GALL BLADDER; APPENDIX AMPUTATED,
AND THE STUMP INVERTED INTO
THE CÆCAL CAVITY. RECOVERY.

Mrs. E. S., aged 46, came under my care January 5, 1891, with symptoms of appendicitis which had existed for a week. Pain had been a prominent symptom, with elevation of temperature, abdominal distention, constipation, furred tongue, and persistent vomiting. Directly over the ileo-cæcal region there was a tumor which was slightly movable and exceedingly painful upon pressure. There had been no previous attack of pain in this region, no chill and no sweating. The symptoms pointed to irritation

or inflammation of the appendix or pericæcal region, but not to abscess; but the presence of the tumor was very puzzling, and its character could not be made out. These were the symptoms indicating a first attack of mild appendicitis, and yet a large circumscribed tumor, painful to pressure, was likewise present; but the fact that this tumor was somewhat movable led to the view that it could not be connected with the appendix; at all events, it seemed proper to open the abdominal cavity, explore it, and examine the appendix, and then to be guided by circumstances.

A lateral section was made on the eighth day. Upon entering the abdominal cavity, the tumor proved to be an immensely elongated and distended gall-bladder, which was about five inches in length, lying directly above the appendix region, and in size and shape resembling a small banana. A careful examination of the liver failed to show the presence of any gall stones. The appendix was found greatly thickened, but free from adhesions. It had an extensive mesentery, which was ligatured and removed with the appendix. The stump of the latter was inverted, and invaginated into the cæcal cavity. The peritoneum was then brought over the inverted tissues by five sutures. The wound was closed with deep and superficial interrupted sutures; drainage was not used.

An excellent recovery followed, and the gall-bladder has apparently resumed its normal size.

Dr. Morris Longstreth, who examined the appendix, reports: "Great hypertrophy and thickening, especially of the mucous coat, and ulceration in two places, which appeared to correspond with the enlarged solitary follicles."

GANGRENE OF THE APPENDIX VERMIFORMIS,
WITH NECROSIS OF MESENTERY AND ILIUM;
PERICÆCAL ABSCESS WITHOUT SPECIAL
SYMPTOMS. LAPAROTOMY. DEATH.

On Tuesday, March 6, 1890, in response to a telegram from Dr. Phillips, of Trenton, N. J., Dr. DaCosta and I visited a patient with him in consultation. The message stated that the case was one of volvulus, and requested me to come prepared to perform laparotomy. The patient, who was about 42 years of age, had been apparently in robust health, had remained indoors on the preceding Saturday. He had been constipated, for which a laxative had been given, but no relief was obtained. All efforts during the succeeding four days to procure an opening of the bowels signally failed. During this period there was no special symptoms except nausea, and occasional vomiting. After a careful and thorough examination, we were unanimous in the opinion that a positive diagnosis could not be made at that time. It was stated that there had been little if any pain in the abdomen, which was not abnormally distended; the temperature had been normal; there had been no chills or rigors; no acceleration of pulse; the principal

symptom being simply a refusal of the bowel to respond to cathartics and enemata. There seemed to be more of a bowel paralysis rather than obstruction from twist or invagination. There was no symptom of peritonitis or other grave lesion of any of the abdominal contents. On inquiry, it was stated positively that there had never been any previous attack of pain in the appendix region. After a most careful consideration of the case, we were unanimously of the opinion that the idea of an operation could not at that time be entertained, and was not justifiable, but agreed that calomel should be administered in fractional doses, $\frac{1}{10}$ of a grain every half hour, with an occasional dose of podophyllan, and as much nourishment as possible.

On separating it was understood that we should hear, promptly, if there was any unfavorable change. Early the next morning Dr. Phillips telegraphed: "Treatment agreed upon yesterday has been carried out; general distress and distention increasing; strength is less, temperature sub-normal. I think, as does the patient, that the operation should not be deferred." Upon my second visit, I found the patient with marked hiccough, and an irregular feeble pulse with slight abdominal tension, and no marked pain. There had been no movement of the bowels. The belief that some grave lesion existed, was warranted by the prostration, the sub-normal temperature, the weak pulse and the loss of strength, but there was no evidence of peritoni-

tis, local or general. In other words, the symptoms were negative, and it was impossible to clear up the diagnosis even at this time. Although the patient was in an exceedingly grave condition, I quite agreed with Dr. Phillips that an exploratory operation was justifiable. Ether was administered, a two-inch incision was made in the median line, and an exploration was made with the finger. To the left of the umbilicus, and extending from just above to just below its level, was a mass of collapsed intestines, but nothing abnormal was found, except slight distention, in any portion of the abdomen until the exploring finger was carried deeply into the right iliac fossa, where it plunged into a very foul abscess, and pus flowed freely from the wound. The incision was then considerably enlarged. In this cavity was found an enormous appendix vermiformis, inflamed and gangrenous in places which was ligated and cut off. The boundaries of the pus cavity comprised the under surface of the cæcum and ascending colon, iliac fossa, mesentery and portions of the small intestine. The portion of the wall made up of mesentery, was necrotic for quite a distance at or very near its root, and the ilium was covered with lymph, and for some inches showed structural change. The sloughing portions separated as soon as touched and bled vigorously. The bleeding vessels were taken up by ligatures, in part individually, and in part *en masse*. Evisceration had been necessary to get at and tie off the

appendix. The intestines were now, with some difficulty, returned and the abdominal cavity thoroughly washed out. A glass drain was carried deeply into the pelvis, and the parietal wound sutured.

It was expected that extensive necrosis of the intestine would occur, if it had not already started, because of the condition of the mesentery. No other operative resource seemed possible in this most desperate case.

The presence of such serious disease was a matter of profound surprise, and was totally unexpected, for none of the symptoms pointed to the existence of such a complication, and the diseased conditions could not possibly have been diagnosed by the symptoms. It is most extraordinary that such destructive changes could have existed without symptoms indicating such lesions, and I know of no instance, in my experience, where such disease existed without equally positive symptoms. The only symptoms which heralded the grave condition, subsequent to the visit of Dr. DaCosta and myself, were those already alluded to, viz.; the hiccough, irregular pulse, sub-normal temperature and failure of strength.

Subsequent to the operation there was a marked improvement in every respect; this was due to the removal of the purulent matter, and foul contents of the abscess cavity, while the fatal result which took place two days subsequently was due to exhaustion incident to the gangrene.

The question was raised at the time, whether or not, if the operation had been performed on the day Dr. DaCosta and I saw the patient, the result would have been different. To this I replied, that after the most careful consideration it was agreed that the safest course was to wait; that the diagnosis of volvulus and intussusception was abandoned, as well as peritonitis; of the latter, indeed, there was not a symptom present. Indeed, had laparotomy been performed twenty-four hours earlier we would have found almost precisely the same fatal conditions, for such extensive disorganization is of slow and not so rapid growth. Dr. DaCosta, having read this report, has written: "I have read the above and concur entirely; no earlier operation could have had a different result."

In reviewing the history of this case, I am at a loss to be able to see in what way a diagnosis of such a condition could be made; for it seems almost impossible that with inflammation, abscess, obstruction of the bowels, from lymph and gangrene, there should not have been some positive symptoms. On making further inquiries subsequent to the operation, it was stated by a member of the patient's family, that about two years before, the patient had a serious but brief attack of pain in the appendix region, which was not relieved until after the administration of a hypodermic of morphia; so that, unquestionably, the appendix had during this time been diseased, and was the cause of the

fatal attack. Had the fact of a previous attack of pain in the ilio-cæcal region been known prior to the operation, it would have been sufficient to elect a lateral instead of a median section, but at the time we were called to the case, it would not have made any difference in the ultimate result.

PROBABLE PERFORATIVE APPENDICITIS; ABDOMINAL TUMOR SUPPOSED TO BE MALIGNANT; EXPLORATIVE LAPAROTOMY; DIAGNOSIS OF MALIGNANT DISEASE RE-AFFIRMED; SUBSEQUENT DISCHARGE OF AN ABSCESS INTO THE URINARY BLADDER; CLOSURE OF FISTULA. RECOVERY.

On the 23d of last June, Mr. T. H. W., aged 33, from North Carolina, came under my care, as a private patient, in the Orthopædic Hospital, with the following history.

About six months previously, or just before Christmas, in 1889, he first had pain in the lower abdominal region; more frequently at night, and was very constipated. The pain lasted about ten days, then gradually subsided, and during this time he was obliged to lean forward in walking, owing to a sense of drawing. About the 25th of April following, when in Scranton, Pa., after feeling poorly all day, he experienced a very severe attack of pain in the lower abdominal region, which lasted for many hours, and was only relieved temporarily by opium and hot applications. Two days later, although very weak, he went South. On the journey he had a very se-

vere chill, which was followed by fever and pain, the latter continuing all the time; his temperature ranging from 100° to 101° ; at the end of ten days he was compelled to go to bed, blisters were applied on account of pain. A hardness and swelling now appeared somewhat to the right of the median line, but below the umbilicus. The diagnosis of local peritonitis was then made; mercurial ointment was applied (which subsequently caused salivation), and low diet ordered. His temperature ranged from 96° to 102° . His condition finally became so alarming that he concluded to come North. On the way up, he consulted Dr. Hunter McGuire, at Richmond, Va., who suspected an abscess and suggested the use of the exploring needle. This was declined, and he reached Philadelphia on June 16th. He was admitted to the Pennsylvania Hospital under the care of Dr. Ashhurst, who diagnosticated carcinoma of the omentum and bowel. After remaining a week in that institution, he placed himself under my care, as a private patient, and entered the Orthopædic Hospital.

At this time I found him emaciated, with great loss of strength, a temperature not much above 100° , but fluctuating. On examination I found marked hardness of the tissues in the anterior belly wall, a considerable tumor which extended from just below the umbilicus to the bladder region, situated over the right iliac region, but not completely. The tumor was hard, more or less irregular, and painful to deep pressure.

The history of the case was that of local peritonitis, and the symptoms pointed to deep abscess, yet as the more marked hardness and tumefaction was confined to the central abdominal region, the question as to the appendix being the source of the trouble was held in abeyance. Hot fomentations were applied, and large amount of milk, nutritious foods and stimulants were ordered.

A few days later I left the city for a trip to the Pacific Coast. During my absence the patient had another acute attack of pain, with marked fever; the only comfortable position he could secure was with the knees drawn up and his body bent forward. Dr. Agnew was called in, who confirmed the diagnosis of malignant disease. After a residence of three weeks in the hospital the patient went to Scranton, and was under Dr. Logan's charge. He subsequently got very weak, his temperature ran high, his pain was severe, and there was progressive loss of flesh. On August, 3 Dr. Mordecai Price visited the patient at his home, and an exploratory abdominal incision was made; the intestines and omentum, it is stated, were found matted together by what was pronounced to be carcinoma, and the opinion was given that he would probably not live through the month. For a week the patient was in a bad condition, chiefly due to obstinate constipation, high temperature, severe pain. Three days after the operation he passed per urethram, what seemed like the "stem of a water lily," of

a reddish black color (probably a blood clot). He had great burning at the end of micturition, and the urine had a foul odor and contained pus. At times, subsequently, the amount of pus was one-third of the urine passed ; gradually the pus disappeared and the urine apparently became normal, of natural odor and color, and would so continue for periods varying from five days to two weeks, the latter being the longest interval. It was very noticeable that when the pus was not discharged from the bladder the patient's temperature increased and general symptoms were less favorable. He frequently passed in the urine, masses of brownish or slate colored tissues in a state of decomposition. This continued right along until early in December, although he gained some 15 pounds in weight, when I visited him at his home in Glenburg, near Scranton. He was then in bed and passing large amounts of pus with the urine ; and then, for the first time, considerable gas escaped by the urethra, especially at the close of urination. On further examination, I found that subsequent to the exploratory laparotomy and the discharge of pus, that the tumor or hardness of the abdominal wall gradually lessened, and finally disappeared, with the exception of a slight hardness which led from the bladder region to the right iliac region. A careful survey convinced me that the patient was the subject of a fistula which had extended from the appendix, that this organ had been originally inflamed, had become surrounded by lymph, had

subsequently perforated when abscess formed, that the adhesions had taken place with the abdominal wall, and finally the pus track led on to the bladder, into which an opening took place, through which the abscess contents, pus, foreign matters, and gas were discharged. The patient was placed on milk, with directions to increase the amount to three quarts daily, also extract of malt and as much nutritious food as could be digested. When his condition warranted, I advised that he should come to Philadelphia for a section and removal of the appendix. His condition after this improved rapidly, no further abscess appearing. He came again to the Orthopaedic Hospital on December 27. From that time, however, he improved rapidly, gaining nearly a pound a day, and was soon able to walk out. The hospital record states: "The abdomen is neither scaphoid or prominent; below the cicatrix of operation and towards the pubes there is some slight but deep induration, but no tenderness." Urine was examined and found to be normal. It seemed reasonable that with the improvement of health the fistulous track might have closed naturally, so that on January 12, after a short residence in the hospital he was discharged apparently cured, with the understanding that should any further evidence of the trouble appear, the source of it should be investigated and eliminated by abdominal section. He is at this time apparently quite well.

The following case illustrates the grave danger

which arises from bands of lymph adhesion, which are liable to be thrown around the appendix as a result of repeated attacks of appendicitis. Such adhesions may prevent the surgeon, at the time of the operation, finding the perforated organ, which not being removed, is likely to give rise to fæcal fistula; and I have seen several such cases

PERICÆCAL ABSCESS; LAPAROTOMY; ADHESIONS; APPENDIX NOT DISCOVERED; RECOVERY WITH FÆCAL FISTULA; FIVE MONTHS LATER ABDOMEN RE-OPENED, FISTULA FOUND AND CLOSED; RECOVERY.

George I., aged 30, a patient of Dr. Benj. F. Butcher, of Philadelphia, was admitted into the Pennsylvania Hospital, May 12, 1890, in an exceedingly prostrated condition, with a history of former attacks of pericæcal inflammation, the last being followed by symptoms indicating perforation of the appendix and abscess.

The attack came on suddenly, with pain in the appendix region, which was greatly increased by pressure; there was nausea, fever and constipation; later on there was a sudden accession of intense pain with deep swelling, and general abdomen tenderness and tympany; a fluctuating temperature, chills and profuse sweatings. The skin over the ileo-cæcal region became discolored, somewhat œdematous, but no distinct tumor could at any time be felt, yet there was some hardness of the deep tissues.

Such was the condition in May, 1890. A lateral incision was made directly over the region of the appendix, which exposed a large abscess cavity containing foetid pus; careful search failed to discover the appendix, but the surroundings were so matted together by adhesions that further exploration was not deemed prudent. It was supposed that the entire appendix had sloughed from the violence of the inflammation, which had doubtless resulted in gangrene of the entire organ.

The abscess and abdominal cavity were thoroughly washed, and two drain tubes were inserted, one of glass to the bottom of the abdominal cavity, the other a rubber tube into the most dependent part of the abscess cavity. A rapid recovery followed, but a fistulous opening remained which now and then discharged excrementitious matter, showing that an opening existed into the intestine, which was probably at site of appendix.

In October, I made a second section, for the purpose of closing the fistula. The incision was made directly in line with that of the first operation; on reaching the cæcum it was found that all the adhesions which were present at the first operation had been absolutely and completely removed. The cæcum was now readily manipulated, and it was found open, as supposed, at the site of the appendix, which had unquestionably sloughed off; the fistula was of sufficient size to admit the end of the little finger. This was

closed with nine Lembert sutures ; recovery was rapid and perfect.

As a result of repeated attacks of appendicitis extensive adhesions may surround the intestines also and cause fatal obstruction, as illustrated in the following cases :

PERICÆCAL ABSCESS. OPERATION REFUSED.

PLASTIC PERITONITIS. DEATH.

In the spring of 1890 I saw, in consultation with Dr. Trautman, of Philadelphia, a young man of 28 years of age, who had been confined to bed for a week, with all the symptoms of violent appendicitis. There was no defined tumor, but indistinct local hardness and general tumefaction. Temperature slightly raised ; there was constipation, and pain, which was marked, was increased on pressure. There was also a history of several, perhaps three, former attacks, but not so severe as this one. I advised a lateral section and removal of the appendix, which sooner or later, I judged, would perforate and probably excite general peritonitis. The patient declined the operation. He subsequently had two attacks, in May and July.

Early in the following fall, the patient sought admission into the German Hospital. It appears that he was then suffering from another attack similar to the one in which I saw him. The trouble was at first supposed to be a retro-peritoneal sarcoma ; then it was taken to be chronic peritonitis. He died of exhaustion, with symp-

toms of obstruction. The autopsy revealed an extensive, adhesive, or plastic peritonitis. The intestines, stomach, liver, spleen and bladder were so united as to form one huge mass, which, when loosed along the vertebral column, was lifted out entire; the appendix, which was undoubtedly the source of the trouble, was found firmly adherent to neighboring loops of intestine, with much inflammatory tissue.

The following case occurred very recently :

OBSTRUCTION OF THE BOWELS, PERSISTENT VOMITING. PURULENT PERITONITIS; SECTION; EXTENSIVE ADHESIONS FROM PREVIOUS ATTACKS OF APPENDICITIS; GANGRENE WITHOUT PERFORATION OF THE APPENDIX; DEATH ON THIRD DAY.

Mr. J. E., 32 years of age, living in Philadelphia, on January 21, 1891, was awakened early in the morning by violent pain in the abdomen, referred to umbilicus and right inguinal region, with persistent vomiting. Bowels constipated, but had a small passage on the 20th. He had a similar attack last October, while away on a hunting trip, by which he was confined to bed for seven days. He then returned to his home, and was confined to his bed for some time with similar symptoms, from which he gradually recovered. In December he had another attack. He stated, however, that he occasionally had pain in the appendix region, especially when stepping out of his carriage or when his body was jarred, impressing him with the fact

that everything was not right. He had had a similar attack in 1887. I was called in on January 22, by Dr. Woodbury, who had first seen the case the day before and had given him a cathartic and large enemata, without succeeding in evacuating his bowels. (His family medical attendant, Dr. Hetzel, was present, and agreed with us as to the necessity of laparotomy.) The operation was performed the same afternoon, by lateral incision. Pus escaped from the peritoneal cavity, showing commencing general peritonitis. The appendix, which was firmly adherent its entire length to the cæcum, was found with some difficulty. It was gangrenous, and tore while being examined. A ligature was thrown around it near the cæcum, and the very large, swollen organ removed. It was the largest I have ever seen. A glass drainage-tube was introduced deep into the pelvis, and small doses of calomel and soda given to check vomiting and move the bowels. There was so great prostration that further examination of the condition of the intestines could not be made. The pain and other symptoms of peritonitis immediately ceased and did not return, but the bowels could not be made to move. The patient vomited all nourishment, even water, and died exhausted on the evening of the 24th day of January.

The several attacks of peritonitis had resulted in general plastic exudation of the bowels, which caused the fatal obstruction—the final abscess, due to gangrene of the appendix, being only an incident in the final result. The operation should

have been performed at an earlier period in the history of the attacks and before the occurrence of the extensive adhesions, when the disease was simply appendicular.

PART II.

TREATMENT AND TECHNIQUE OF OPERATION.

First Group: The treatment of the first group of cases, the irritative, catarrhal, or simple inflammatory disorders of the cæcum and its surrounding, or of the appendix, should consist in absolute rest in bed, the application of hot poultices or fomentations, perhaps local depletion, and possibly the hypodermic exhibition of morphine to control pain. The bowels should be kept open by the administration of calomel, or salines and enemata. The diet should be restricted to nourishing liquids.

Second Group: In this variety of cases the disease is no longer simply irritative, catarrhal or inflammatory, but there is ulceration, with impending perforation, if the latter has not already occurred. Lymph, as a result of the violence of the disease, has been thrown out, which has either partially or completely enveloped the appendix, or this lymph exudation may have formed a wall sufficient to protect the general abdominal cavity when perforation and abscess have occurred. Perforation means pus and abscess; the diagnosis, therefore, of such a condition calls at once for abdominal section and removal of the appendix.

In a paper which I read more than a year ago, before the College of Physicians of Philadelphia,

on inflammation of the vermiform appendix, I stated that "when the abdomen is believed to contain pus, whether intra- or extra-peritoneal, encysted or diffused, the rule of surgical procedure now is to make a section, remove the offending organs or the sloughing tissues of pus, thoroughly cleanse the surroundings and drain." This rule still holds good, and is being constantly followed with the happiest results.

The risks of operation at this time, are much less than those which threaten the patient. Early interference will save most if not all cases, while the danger of operation is slight as compared with that of general abdominal inflammation. The surgeon should never be satisfied in merely opening the abscess, which is simply a result, and not the cause of the trouble; if this only is done, the operation is incomplete, and at any time may have to be repeated.

Third Group: Here we have sudden perforation or sloughing of the appendix; in these cases there is no lymph wall separating the pericæcal surroundings from the general abdominal cavity, nor has the appendix been enclosed in lymph exudation—so that when the perforation occurs, the sloughing tissue, pus, and contents of the appendix are at once brought in contact with the general peritoneum.

The symptoms are at once profoundly grave, indicating general peritonitis and early collapse. Immediate section, removal of the appendix and

cleansing of the abdominal cavity and contents, is demanded.

It is hardly necessary to say that the usual precaution in regard to cleanliness and rules of strict antisepsis should be observed. Generally, from the very nature of the case, there is but little time for any special preparatory treatment, prior to the operation.

OPERATION.

In my papers on the treatment of pericæcal inflammation, read before the Philadelphia County Medical Society, in December, 1889, and again in January, 1890, before the College of Physicians, I stated that the line of abdominal incision should be lateral, and not median. The reasons for this statement are very obvious and positive; for, if the median incision be made, the peritoneal cavity would often be needlessly opened, while the cæcum and appendix can not be well reached or dealt with through it. But if the lateral incision is done, it can be made of less size, more circumscribed, and all the necessary manipulations can be made upon the cæcum, appendix, and surrounding parts without necessarily opening the peritoneal cavity. Should the abscess have reached the cavity of the peritoneum, the intestines can just as well be examined and cleansed through a lateral as a median incision. The incision should ordinarily be from three and a half to five or six inches in length. Starting from about an inch or so above the middle of Poupart's ligament, and to the outer side of

the right line a semi-lunaris, it should extend upward and outward and directly over the appendix region, and be continued down until peritoneum, cæcum, or pus cavity is reached. The normally placed appendix, as I first pointed out, can always be found immediately under a point two inches distant from the right anterior superior spinous process, on a horizontal line drawn from this process towards the median line of the body. In some cases where the peritoneum is reached, its discoloration shows that it covers a pus cavity; in others, after the peritoneum is opened, not only pus but a lymph tumor enclosing the appendix, is found; this mass must be opened before the organ be dealt with.

Occasionally, when the abscess is cleansed, the appendix will be seen loosely floating, but frequently it is more or less attached to the cæcum, sometimes firmly fastened to it and detached with difficulty. Now and then it has a mesentery of its own, which may extend its entire length; this must first be tied in sections and then cut away: the appendix is then ligatured with catgut, or silk, close to its cæcal attachment and cut off. There is no advantage in invaginating the stump; in most cases, indeed, this treatment would really be impossible on account of the swollen, infiltrated and unyielding condition of the organ. In such cases there is no reason why the ligatured stump should not be allowed to project from the cæcum. The abscess cavity must slowly fill up and close by granula-

tions. If the general peritoneal cavity has not been involved, the abscess walls and surroundings need only be washed out with hot water (or with 1 to 2,000 mercuric solution). If the appendix has sloughed, or even simply is perforated, search should be made for any foreign body, and all sources of further trouble gotten rid of. A glass drain should be placed in the most dependent part and the wound closed with a few stitches. Very commonly, however, the peritoneum is found invaded by pus, so that the whole abdominal cavity needs to be thoroughly drenched with hot distilled water (105° to 110°). In such a case even greater care should be taken to find any foreign body which may have escaped from the appendix.

When the general cavity has been involved, a glass drain must be carried to the bottom of the pelvis in the hollow of the sacrum, a large rubber drain should also be placed in the superficial or cæcal abscess cavity.

The post-operative treatment is simple; it consists in the hypodermic use of small doses of morphia to relieve pain, while the ordinary rules of abdominal surgery are to be observed. No food need be given, by mouth, for the first twenty-four hours, or even longer. Nutritive enemata of beef tea, with or without whisky, can be administered every three hours with advantage. The bowels should be opened as early as possible, and for this purpose, small doses of calomel, one-sixth or one-tenth of a grain should be given

half hourly, with an occasional one-eighth or one-tenth grain dose of podophyllin. When the bowels have acted, they should be kept in a fairly soluble condition by salines; even threatening peritonitis should be met by saline purgation.

The drain tubes may be removed as soon as the discharges are perfectly sweet, and reduced to a minimum. After recovery, the site of operation should, for a time, be supported by a flat, thin buckskin pad, kept in position by a broad band around the body, in order to avoid the occurrence of hernia.

PROPHYLACTIC TREATMENT.

This paper would be very incomplete, and I should not do justice to the subject, if I close my remarks without referring to the mooted question of the removal of the appendix in the interval between acute attacks. In fact, I have long urged, indeed from my first writing on this subject, that recurring attacks of appendicitis should be an absolute indication for the removal of the appendix at this most convenient time. When we remember that the appendix, which has been the subject of former attacks of disease, is liable at any time to be involved in that most dangerous of acute affections, perforation of the organ and pericæcal abscess, and when such a seizure may take place where adequate medical skill cannot be had, it seems much safer to avoid the possibility of future trouble from this source, by getting rid of the appendix when its surround-

ings are free from active irritation. Objection is made, and very naturally, to such a radical operation as excision of the appendix, especially when the patient is in a favorable condition or has apparently recovered.

If, however, health has become impaired by one or more attacks of mild or serious seizures, and if these attacks have increased in frequency, severity, or duration, the removal of the organ is clearly indicated. The premeditated operation permits the careful preparation of the patient. The incision should be made in the same line as previously described, but it need not be more than three inches in extent. All bleeding points should be ligatured with fine catgut, when the peritoneum is reached, and after the wound is quite free from blood or other fluid, the peritoneum is incised. The omentum or intestine will then present itself in the wound; rarely will the appendix be seen until the bowel is pressed aside to the right with the finger. It may be found partially or entirely attached to the cæcum or elsewhere; if so, the adhesion may be separated by the finger, and divided between double ligatures. The appendix may be quite free from mesentery, or, as I often observed, it may extend throughout its entire length; should this be the case, the meso-appendix is ligatured in portions and then cut through between the ligatures and the appendix; the latter is then cut off near its cæcal origin. If the stump be permitted to remain projecting from the cæcum,

free it must be included in a ligature, and its extremity covered by peritoneum.

I originally, in 1889, called attention to the fact that the stump of the appendix could be readily inverted and completely invaginated into the cæcal cavity, hence all danger from it could be gotten rid of. The manipulation consists in grasping the stump with a forceps or probe, and pushing it into the cæcum; the peritoneum is then approximated over the inverted stump by four or five sutures, which retain it in the cæcum, and effectually prevent its subsequent prolapse. This having been accomplished, the peritoneum is then brought together by a row of interrupted deep sutures, and also the external muscle and skin. Drainage could only be required in very exceptional circumstances. The after treatment is simple; the bowels having been well opened before the operation, need not be disturbed for several days; the dressings may go untouched for a week or even longer, when the sutures should be removed.

IN CONCLUSION.

I have thus gone over, somewhat briefly, the subject of this paper, and have also presented some of the difficulties which I have experienced; such difficulties, however, can generally be overcome. The key to the situation is the diagnosis, which should lead the way to prompt surgical treatment; and finally, if I have not presented anything specially new or interesting, I hope at least that the discussion of such an important subject will prove to be not without some practical value.



1

IS EARLY RESECTION OR CONSERVATIVE TREATMENT ADVISABLE IN COXITIS?

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While our increased knowledge of the pathology of tuberculous joint affections has resulted, in most joints, in earlier operations, in order to remove the local focus before the joint has become totally disorganized, the same cannot properly be said about tuberculous affections of the hip-joint. We still find the same disagreement between the adherents of conservative and operative treatment, and I scarcely say too much when I state that, in the vast majority of cases, excision is still made as *ultimum refugium* only. Yet even in these cases, a better knowledge of the pathology and consequently improved operative methods, have been followed by decreased mortality and improved functional results. In order to decide the question, it seems proper shortly to study the pathology of coxitis. We formerly believed that tuberculous affections of the hip, or, for that mat-

ter, of any other joint, commenced as diffuse inflammations, which went on to destruction of the joint. Post mortem examinations were rare, except in cases which represented the later stages of coxitis. In these the synovial membrane was always found diffusely diseased, the ligaments and the perisynovial tissue changed to gelatinous, oedematous or fibrous tissue, the joint itself filled with fungous granulations, the cartilages generally ulcerated and shed, leaving the epiphyses in a state of softening and caries. But often we found the cartilages more or less intact, and we therefore believed that the synovitis was the primary lesion, the disease of bones and cartilages secondary. The tuberculous bacillus was unknown, and we supposed a dyscrasia present. Furthermore, all acute infectious diseases were known to be followed occasionally by inflammations of the joints, which always commenced as a synovitis, as in pyæmia, puerperal fever, typhus, scarlet fever, etc. It was acknowledged that the inflammation occasionally might commence in the bone, but it was believed that it even then commenced as diffuse inflammation of the medullary tissue in the epiphyses.

We overlooked that these diffuse processes, whether in bone or in synovialis, were secondary, and were the result partly of an infection, partly of reactive and reparative processes.

It is the Germans, particularly the late Prof. Volkmann and Prof. Kœnig, both of whom I quote extensively in this paper, to whom belongs

the credit of proving that the fungous or tuberculous joint affections commence, in the majority of cases, as a local focus in the bone, and that the consecutive entrance into the joints of the *materia morbi* from the local focus produces the diffuse inflammation of the synovialis and the epiphyses. That the disease, in a few cases, may commence as a synovitis, is not denied, and is occasionally proved by post-mortem examination.

This is by no means a generally accepted theory. Habernern, for instance, states that in 132 cases of excision, a primary osseous lesion was present 80 times, 23 times a primary synovial affection, while the starting-point was doubtful in 29 cases. Watson Cheyne thinks the disease more often primarily osseous, although not in the proportion Habernern states. The trouble is that only in early cases can the presence of a local focus be shown. In late cases we find exactly the same changes in bones and joint, whether the disease started as an osseous or synovial inflammation.

It is, therefore, probably true that the vast majority of cases commence, as Volkmann says, as an osteitis and not as an arthrititis, and more particularly as a circumscribed cheesy or tuberculous osteitis or osteomyelitis.

It depends upon circumstances whether the joint later becomes attacked, viz.: whether the products of the inflammation perforate into the joint, as usually, from anatomical reasons, occurs, or seek the surface. The primary focus, at

least in childhood, is always in the bone, either central or near the periosteum. Generally only one focus is present, and it is rarely the case that both epiphyses are attacked simultaneously.

The focus is generally small, as large as a cherry-pit, or at most as a nut. The neck is the point of predilection, in the near neighborhood of the epiphyseal cartilage, or in the diaphysis or trochanter major, while the head is rarely the starting-point. The focus may perforate the epiphyseal cartilage in order to invade the epiphysis. It may even commence as a chronic osteomyelitis in the cavity of the femur, and work its way upwards. Primary attacks of the acetabulum are probably more frequent than generally believed. Habernern states that in his 80 cases, the acetabulum was attacked alone in 50 cases, the femur alone in 23 cases, and both together in 7 cases.

The focus presents itself as a little cavity filled with cheesy granulations and bone detritus, and frequently a sequestrum and surrounded with a pyogenic tuberculous membrane. Sequestra were present 51 times in Habernern's 80 cases, soft caseous deposits 29 times. If the focus perforates into the joint, tuberculous synovitis occurs, with very acute symptoms. If the focus is in the neck or trochanter major, the joint occasionally escapes, the osteitis and abscesses being extra-capsular.

While the osteitic process is going on in the neck and before perforation takes place, we may discover changes in the joint itself. The syno-

vial membrane, the periosteum and the periarticular tissue become more or less infiltrated and cedematous, slight exudation may occur, and a partial obliteration of the joint may take place; little by little the whole synovial membrane may be changed into a granulation-tissue, and yet we have no tuberculous arthrosis. When at last the perforation occurs, it is into a half obliterated joint, and the symptoms are therefore proportionately less, as a joint reacts the more severely to infectious products when the synovial membrane is physiologically intact, and the less severely the more the synovial membrane has been changed into a granulation-tissue. This partial obliteration we meet particularly in the knee-joint, but less often in the hip-joint, where we consequently are more apt to meet acute suppurative arthrosis. Yet even here we occasionally see a central necrosis of the head and neck being followed by an obliteration of the joint, thereafter destruction of the epiphyseal cartilage and diastasis of the head, which meanwhile has become firmly attached to the acetabulum. As a rule, the hip-joint is attacked early, as the whole neck, in which the local focus generally is found, is inside the synovial capsule, but we may see the joint escape even when the focus starts as a central necrosis in the head or neck. A carious fistula may then be found perforating outward through the trochanter major. This point is of importance, as indicating the way in which such a central necrosis may occasionally be attacked, through tre-

phining of the trochanter and the neck or by ignipuncture.

The perforation of the tuberculous local focus having occurred into the healthy or half obliterated joint, farther pathological changes take place, while at the same time the symptoms of coxitis, which so far have been vague and insignificant, become pronounced on account of the implication of the synovial membrane, the cartilages and adjacent Haversian canals. The characteristic symptoms are particularly the starting pains and the muscular contractions, both indicating osteitis in the neighborhood of the joint cartilages, while the position of the limb (abduction, flexion and rotation) is less characteristic, probably depending upon other causes.

The pathological changes are those of a tuberculous synovitis with its resulting destructive processes.

The round ligament, which is covered with synovialis, is early attacked and softened, and then disappears.

The osteitic process generally commences at the place of insection of the sound ligament to the head and acetabulum, and on the neck at the place where the synovialis is attached. The cartilages become ulcerated by pressure of the granulations (Voikmann's Ulcerative Decubitus) or shed by pressure of the granulation-tissue, meanwhile developed in the dilated Haversian canals. The bones are now in a state of osteoporosis; the head loses its roundness and be-

comes smaller from pressure just as the acetabulum enlarges by pressure upwards and backwards, or becomes perforated by gradually developed decubitus, and spontaneous dislocations and intra-pelvic abscesses result. Peri-articular abscesses are rarely the result of the breaking down of granulation tissue in the peri-articular tissue. They occur usually from softening and perforation of the capsule itself. So much in regard to the pathology. Yet I wish at this stage to show a pathological specimen which to the fullest illustrates the pathological process as here described; the patient is a little girl of 10 years of age, who entered the Sister's Hospital in Buffalo in March, 1891. She had then been sick only two weeks, and a physician had opened an abscess on the outer side of the right femur. Contra-openings were made in the hospital and the abscess found to be situated beneath the vastus muscles, but apparently not connected with the hip-joint, which seemed healthy. Two weeks after entering the hospital she grew worse and offered the usual symptoms of coxitis. Under chloroform the joint was examined and a carious process found on the upper side of the neck. A good sized abscess was found in the pelvis and opened. As this abscess was supposed to indicate perforation of the acetabulum, I removed the head and neck, which I here show. You see a local focus in the neck which had opened into the joint, the synovial membrane of which was found thickened and tuberculous. The round

ligament had disappeared and at its place a carious process is going on. The cartilages are yet healthy. I suppose the carious process on the upper surface of the neck gave occasion to the first abscess, and that the tuberculous focus perforating into the joint produced the acute symptoms of coxitis. In this case the excision was performed about four weeks after the beginning of the disease. In another case, operated at the same time, the disease had lasted two months. I found there a sequestrum in the neck, three-fourths of an inch long, a perforation into the joint, shedding of the cartilage, osteitis of the epiphysis, diastasis of the epiphyseal cartilage and tuberculous synovitis. In both cases the operation cut short the disease, the wounds healed rapidly and the final result will be what I have always obtained, a movable joint with some shortening, which is easily overcome by aid of a thick sole. I consider this specimen of peculiar value as showing the condition in the early stage. In later resections, in which we find diffuse osteitic processes of head, neck and trochanter major, destruction of cartilages and tuberculous degeneration of the synovial membrane, it is impossible to find the local focus, as everything is diseased, but that does not prove that it was not present in the start.

Coxitis may under favorable conditions, terminate in recovery in any stage, of course with more or less deformity, and the usefulness of the limb depends upon the amount of flexion and ad-

duction. A perfect recovery with normal joint is rarely obtained. I myself remember only one case. And with what cost is this imperfect recovery with a more or less deformed limb, obtained? It means years of suffering and treatment, be that with extension in bed or with a portable apparatus, frequent operations for abscesses with resulting fistulas, the dangers of amyloid degenerations of liver and kidneys, and of tuberculous meningitis, and lastly of an excision as *ultimum refugium*, at a time when neither the broken down constitution of the patient nor the extensive destructive processes in head, neck and shaft favor reparative processes. In those cases in which we do not have an abscess, the tuberculous focus has probably become incapsulated, surrounded with a zone of sclerotic bone tissue, and the synovial membrane is not tuberculous, although the joint may be partially or totally obliterated. In these cases conservative treatment is probably indicated. But if abscess is present, it shows that perforation has occurred and in my opinion an early operation is the only thing that can arrest the disease.

And yet, why wait for abscess? The tuberculous bacillus, as is well known, is not a pyogenic bacillus and may under favorable circumstances continue to grow and infiltrate surrounding or more distant tissues. If abscess occurs, the pyogenic bacterias, particularly the staphylococcus pyogenes aureus, will always be found present as the cause of the suppuration. The chronic path-

ological process has only become complicated by the acute suppuration, and the tuberculous process keeps up advancing simultaneously with the suppuration.

It must not be forgotten, that the statistics of resection must be compared with the statistics of those conservatively treated cases, in which abscesses were present. In both classes we find a great decrease in mortality in one time.

Leisrink, for instance, gives a mortality of 63 per cent. after resection, of which 22 per cent. succumbed to wound complications, 21 per cent. to marasmus, 11 per cent. to phthisis, 7.5 per cent. to amyloid degenerati, etc. A more recent English statistic of 320 cases showed a mortality of 40 per cent. Jacobson has increased Leisrink's statistics of 176 cases to 250 cases and finds a mortality of 40 per cent. The result of conservative treatment was even worse. Of 63 conservatively treated cases in Copenhagen 73 per cent. died and 27 per cent. recovered. An English statistic of 384 conservatively treated cases, in all of which abscesses were present, showed a mortality of 67 per cent., a recovery of 33 per cent.

If abscess was not present, 69 per cent. recovered. Grosch (1882) found a mortality of 28 per cent. under antiseptic treatment.

Koenig states in a recent work, that it is an exception that a patient dies after resection of acute or chronic sepsis. In spite of the decreased mortality following resection, surgeons still differ

in regard to the advisability of conservative or operative treatment. Two English surgeons of large experience, March and Wright represent well the different opinions. March is strictly conservative and considers excision uncalled for. Continued rest, he says, gives a mortality of only 5 per cent., and 70 per cent. recover with slight lameness and loss of motion. Even when suppuration has occurred he gives a mortality of only 6 and 8 per cent.

Dr. Wright, on the other hand, with an experience of more than one hundred cases of excision, of which only three died as a result of the operation, strongly advocates excision as soon as external abscesses occur, yes, even before the capsule has been perforated. He maintains that excision cuts short the disease, saves pain, lessens the time of treatment and gives a better functional result. Osteomyelitis once established, nothing short of excision can, in his opinion, prevent the progress. Nature can, of course, get rid of the caries and necrosis, but the children who can survive the elimination are few, except among the well to do. The decreased mortality and the better functional result are the result of our increased knowledge of pathology and improved operative methods. Formerly we simply excised the head and perhaps neck and trochanter, but we left the tuberculous synovial membrane and discredited the operation because, as might be expected, suppuration continued or increased and our patients died of marasmus, amyloid de-

generations, tuberculous meningitis or phthisis. Modern pathology has taught us that coxitis is primarily an osteitis, secondarily, a tuberculous synovitis and arthrititis, and that it is necessary not only to remove the bone affection, as we formerly did, but to remove the tuberculous synovial membrane just as well. If anything is left of that, relapse is sure to occur. The same is true about the tuberculous pyogenic membrane covering the abscess. If all diseased tissue of bone and synovial membrane is removed we may get healing of the wound by first intention even, just as we see it in operations on the knee-joint. I am even inclined to go a step farther than Wright, and advocate still earlier operation in order to remove the local focus before diffuse inflammation of bone and joint has occurred. I tried this recently in the case of a little girl, who had been sick six weeks and who had considerable infiltration around the neck. I made an anterior incision (Barker's), between Sartorius and tensor vagina femoris muscles and exposed the neck with ease, the extensor quadriceps femoris being pulled inwards. I found under this muscle a great mass of tuberculous material, which had not yet broken down into pus, and removed it, but I could not find the local focus, although, by flexing the hip-joint, I could examine the whole lower surface of the neck. I closed the wound with sutures and it healed by first intention. She did not improve, and three weeks after I resected the joint, found the seques-

trum, three-fourths inch long, near trochanter, and a complete disorganized joint, diastasis of the epiphyseal cartilage, etc. The patient left the hospital recovered in three weeks. I show you the preparation here.

Mr. W. H. Battle reports a similar case in the London Clinical Society. He successfully removed a local focus, washed out the joint, and the child recovered in four weeks.

If the disease commences in the acetabulum (and according to Habernern this should occur in five out of eight cases), operation would be still more indicated, as the dangerous complication of intra-pelvic abscess is apt to follow. This complication has formerly been considered an absolute indication for resection, but Bardenheuer, of Cologne, has several times resected acetabulum in such cases, by aid of his symphyseal incision (extra peritoneal explorations—Schnitt). But even if it is possible, yes, comparatively easy, to resect the acetabulum in this way, we are forced to leave behind the tuberculous synovial membrane and the secondarily affected head and neck of the femur, and the disease, I judge, would proceed in spite of this operation.

Still one question remains, whether the limb is better after the excision or after conservative treatment?

Holmes thinks that shortening is generally greater after excision and the limb less firm and less useful. Motion is more frequently present and more extensive, but the patients walk more

insecurely and with more limp. Jacobson thinks the average results obtained by conservative treatment superior to those following excision, particularly in adults, where we often get flail-joints after excision.

Wright, with his large experience, thinks that excision gives better results and that much shortening depends upon using the limbs too early.

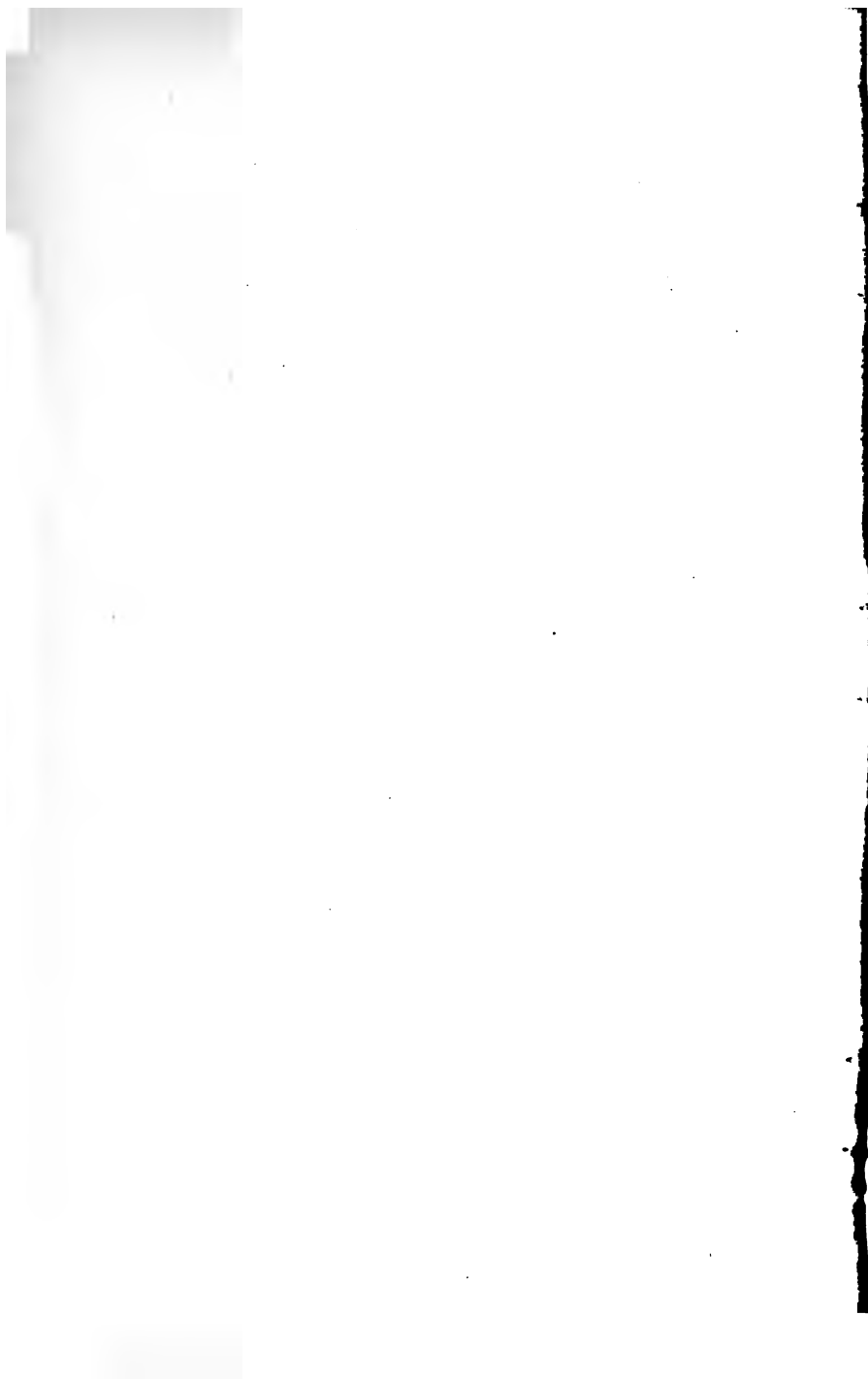
It is evident that the best result following excision cannot compare with the best result following conservative treatment: *restitutio ad integrum*. We must compare those conservatively treated cases, who have got well in spite of abscesses, caries and years of suffering, with those, in which, for the same reasons, excision was made. Few get well by conservative treatment, extending during years, without considerable flexion and adduction. To treat such a case demands such continual patience from the side of the parents, the patient and the surgeon that a good functional result is almost out of the questions unless the patient be treated in a hospital, where the surgeon has complete control over the patient and nurses. It might therefore more properly be asked, whether a flexed and adducted limb is more useful than a shortened limb after resection?

Judging from my own limited experience, I believe that excision gives a better functional result and a better looking leg than does conservative treatment in the majority of cases, particularly if you can sever the bone above trochanter

minor. If you are forced to go below trochanter minor you are very apt to get a flail-joint. In early, or comparatively early operations, the disease will probably always be found confined to the head and neck.

I have during the last few years resected the hip-joint ten times, eight of which recovered with good and useful limbs, two died of other causes, independent of the operation.

The earlier the operation has been done, the better has the functional result been and the quicker the recovery. The last two cases, the pathological specimens of whom I have shown here, left the hospital with healed wounds in three or four weeks, but have, of course, not yet been allowed to use their resected limbs. Most of the cases presented themselves in the third stage of coxitis with extensive carious destruction, large abscesses and broken down constitutions. Yet even these cases, who had been treated conservatively for a long time, were by prompt excision restored to health and comfort and provided with a firm and useful limb.



OSTEO-PENTHESIS.

BY B. MERRILL RICKETTS, M.D.,
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I wish to call your attention to the subject of osteo-pentthesis, the subject of which I made brief mention at the last meeting of the New York State Medical Association, which convened in New York City.

Dealing with bone tissue has been one of the most interesting subjects to me, and I may say to surgeons in general.

The three principal points which I wish to bring out in this paper are as follows:

First: How and when may bones be restored?

Second: Should fragments of the bone be permanently removed except in case of amputation?

Third: Should not exploratory incisions be made in cases of fracture of bones where doubt exists as to their character?

I cannot do better, after making brief mention of these three interesting features, than to report the observations I have made in experimenting with the lower animals.

In the first case: How and when may bones be restored? I would say, in this class are included those cases in which the restoration of the bones, of the hands, feet, arms and legs have been removed by trauma or surgical interference without amputation.

Bone grafting, or osteo penthesis, is subject to as great a number of successes as skin grafting.

I am thoroughly satisfied, after having carried on my experiments, during the past year, that its confines are not narrow by any means.

It was Poncet, who restored the tibia within nine months, by grafting to the superior articular surface. The replanting of trephine buttons is now the established rule.

The dentists have accomplished a great deal in transplanting, replanting and implanting teeth.

The series of experiments that I have adopted to show what can be done in the way of substitution, that is, transplanting the bone of one animal to another, is not as yet complete. Suffice it to say, that enough has been accomplished to satisfy me that sooner or later, the long bones and ribs of the lower animals will be successfully transplanted for the purpose of restoring osseous structures, destroyed by any cause whatever, except that of malignancy.

I am inclined to believe that the tails of such animals, as the dog, cat, opossum, etc., after being divested of the integument and soft tissue, may be transplanted with success, as the various

joints will become ankylosed, and they may perhaps supply a long felt want.

It may be found that the ribs of the lower animals can be substituted for metatarsal and metacarpal bones.

In all cases as much of the periosteum should be preserved as possible, and the bones cut with a knife or chisel, or the finest saw that can be had, preference being given to the knife, as the ends of the bones are smoother, a condition more likely to be followed by good results than if severed with a saw. I have not yet been able to save a finger, in case of injury, where the bone was completely divided by a saw; I have, however, been successful in securing union in several instances where the bone was severed with sharp edged tools. In all cases of injury when the bone is divided by the saw there is more or less foreign matter, fine in character, carried into the wound, and its removal is attended by the greatest difficulty. Thus it is these two elements, a roughened bone surface and foreign matter, that make union difficult, and yet, with the larger bones, it is absolutely necessary to use the saw. This once done, the ends may be scraped and perfectly coapted, after which the periosteum overlying the two bones is brought together and stitched with fine catgut.

I will say in this connection that I do not favor the use of the forceps in amputating any member; the objection lying in the possibility of fracture. The saw should invariably be used; with the for-

ceps the work is more rapid but less scientific, and there is no excuse for any man applying them.

Second: Should fragments of bone be permanently removed except in case of amputation?

Bone fragments, in either compound or compound comminuted fractures. Where a bone is crushed or broken into two or more pieces, the greatest care should be taken to replace the fragments, and to offer every opportunity for their union so that its strength and original shape may be preserved. That this may be made more certain, all clots and foreign matter should be cleared away and shreds of tissue removed from between the fragments, which should be immediately restored to their proper places.

In some cases, as in long bones, the fragments may be brought together with a silver wire, which may afterwards be removed.

In dealing with the fragments, cleanliness is, above all things, first to be considered. Each fragment should be thoroughly cleansed with water at a temperature of 115° or 120° . Constant irrigation of the wound with water at this temperature is by far more preferable. If the fragments have been removed from the limb by injury or otherwise, they may likewise be restored. In compound fractures, where there are two or more fragments, it is best to allow them to remain and clean by irrigation and scraping, as the periosteum overlying these fragments will enable union to take place much sooner. If a portion of the shaft has been removed and cannot be found, I

am inclined to think that small fragments, such as shavings and dust, would be the most desirable way of restoring the lost part. These bones may be from the individual himself, or from any of the lower animals. This was first suggested by McEwen, of Edinburg, and it was by this means that he restored one-third of the radius in a boy.

I am also inclined to believe that bone grafting can be more successfully accomplished in persons under 15 years of age than those older. This can be readily understood when we consider the activity of development of bone up to this age. The bone is not so brittle and the vascular supply is more perfect. It is at about this age in life that we cease to find the green stick fractures.

I am also inclined to the belief that bone would be more easily grafted near the epiphyseal line.

It is an established fact that bone cannot be grafted to any other tissue than that of bone, and that epithelial tissue cannot be grafted to any other than epithelial tissue; so that, if we can secure a sufficient amount of periosteum to overlie these fragments or grafts we will have union more certain and rapid.

In cases of compound fractures, especially where the bone has been crushed, we must first ascertain the condition of the blood vessels and nerves. These being intact we may rest assured that our patient loses no time in

making the attempt of saving the fragments or restoring any portion of a bone that may have been removed.

Third: Should not exploratory incisions be made in cases of the fracture of bones where doubt exists as to their character?

Being conscious of the great difficulty that is almost invariably encountered in determining the exact condition and character of fractures, my attention has been especially called to an investigation in this line.

It is so often the case in fracture of the long bones, especially in fleshy persons, that we are utterly unable to determine what the state of affairs is. Until a comparatively recent date the injured extremity was placed in a support of some kind, and the bone allowed to heal *ad libitum*. Now, this having been an established custom for so many centuries, it may seem rather out of place at this time to suggest a different procedure, with my limited experience, from a practical standpoint, but having recently carried my observations over a series of experiments, I feel somewhat at liberty to bring this matter before you.

It is with chagrin and humiliation, many times, that we look upon the result secured in putting these fractures in plaster, or in any dressing whatever, and allowing them to take their course. We have no definite means of determining whether the fracture is transverse or diagonal. Now, this being the case, why are

we not justified in making exploratory incisions in cases of fracture, as well as in obstruction of the bowel?

If cleanliness is the greatest desideratum—which I have every reason to believe it is—if it is through clean surgery that we secure such brilliant results as have been secured within the past, why need we fear any serious consequences in making a simple fracture a compound one?

True, the bone will never be as perfect as it originally was, but then there is the great satisfaction of knowing whether there are one, two or three fractures.

In all cases of fracture, especially compound, there are more or less clots and shreds of tissue, perhaps muscular, ligamentous or cellular tissue, involved in the fracture. An exploratory incision will enable these to be removed and the fragments of bone closely coapted and union made more rapid and certain.

Of course, this procedure would be confined almost entirely to the long bones; however, the same rule would hold good in the injury of the cranium.

In cases of a blow received upon the head, we are not able to determine whether or not there has been a fracture either of the outer or inner table. The infiltration is many times so extensive that it is impossible to arrive at any definite conclusion. Now, why should we refrain from making a simple incision through the scalp, at

any point, when the risks are so slight and where the good to be derived is so great ?

One of the greatest principles involved in surgery, as in medicine, is to determine the cause and the state of affairs.

The sense of touch is of itself one of the greatest means of enabling us to arrive at definite conclusions.

However, the eye is equally important in many things; although it may not be possible to get a view of these fragments, it is possible for us to determine definitely what the condition is, simply by the sense of touch.

Many times the incision may not be any larger than to admit the index finger, but the finger once introduced, the state of affairs may at once be determined and thus save us from malpractice suits and the humiliation that we sometimes experience in treating fractures.

The incision once made, the question would then arise as to how the fragments of the bone may be best secured, that they may be replaced to their normal position and allowed to remain so until Nature comes to our rescue. I would say, in this connection, that I have found nothing to equal the silver wire, secured with an Aveling coil and mounted with a perforated shot. The wire may be passed around the fragments by means of a Collins' needle. The wire is made taut by an Aveling coil mounted by a shot. This may be allowed to remain indefinitely, as it causes no irritation. It may be removed at the end of four,

six or eight weeks, in which case it is best to have the coil to stand at a right angle to the bone or the ends of the wire may be secured, the coil placed parallel with the bone, the periosteum be made to overlie it and allowed to remain. In this case, the bony structure is thrown out and soon encompasses the wire and its attachments. As many of these may be used as may be necessary. So far I have not seen any bad results. With one or two of the dogs I found that the integuments healed and that they caused no serious trouble.

The fragments once secured by this means, the wound should be closed and the drainage tube, which should be rubber, inserted; as we are more likely to need drainage in the reparation of the bone than any other tissue. As to the after dressing, I have found nothing better than the application of simple water dressings. These enable the wound to be kept soft and the discharge to escape freely. Towels saturated in boiled filtrated water, can be applied every hour or so as the occasion may require. It may, or may not, be necessary to place the injured extremity in plaster.

Of all the dressings, I think the plaster is the most desirable. It has been my desire in bringing this paper before you, to excite an interest in this very important matter; knowing that it will require a great deal of time, experimentation and observation to enable us to arrive at definite conclusions, in this as in all other matters, I am desirous of having your coöperation and assistance in bringing this subject before this Association at its next meeting, wherever it may be.



A NEW OPERATION FOR HARELIP.

BY CHRISTIAN FENGER, M.D.,
OF CHICAGO, ILL.

In all forms of harelip (*labium leporinum*, whether single or bilateral, whether partial or total, whether combined with cleft inter-maxillary bone or not), we find not an excess, but rather a defect of labial tissue, mucous membrane, prolabium and skin. The two portions of the upper lip, when brought together, are too small to form a lip of normal shape; it would require the interposition of a triangular piece of lip with apex towards the nose and base toward the border of the lip, to obtain at once a lip of normal shape. The tissue defect is greatest in the skin, less manifest in the mucous membrane and prolabium; still in the majority of cases of complete harelip, the defects in these tissues also may be considerable.

It would thus seem natural to select a method of operating by which no tissue should be lost. In all the older methods the so-called "freshening" of the surfaces to be united requires the removal of at least a part of the prolabium, in

some more, in others less, at the best, as in the method of Nélaton for small harelip, a displacement downward, to form a projection which must either disappear by retraction and atrophy, or be removed, if present in excess, by a secondary operation.

About five years ago I was led to consider this question in a case of double harelip with rather defective lateral portions, in which I operated after the old method and suppuration with consequent non-union took place. At the next attempt at union, the increased defect of tissue made union still more difficult than at the first operation. I therefore concluded to operate in my next case without the removal of any tissue, so as to have at least not lost anything in this respect if suppuration and non-union should make one or more later operations necessary. When I commenced to operate in this way I found it necessary to apply a separate row of sutures to the prolabium before bringing the edges of the skin together, thus closing the wound toward the mouth, and I soon found this to be a protection against infection.

I have since that time never had any reason to abandon this method for any of the older methods.

I. OPERATION FOR UNILATERAL HARELIP.

I. *Incision*.—The incision is made at the border of the skin and prolabium, four to six millimeters or two to three lines deep, care being taken to guard against opening through the mucous membrane into the mouth.

It is necessary to draw the lip down in order to procure sufficient tension for the knife to divide the tissues ; this traction causes anæmia of the border of the lip, making the line between the white skin and red prolabium indistinct. It is necessary to be careful to have the incision precisely in this line, because a small margin of prolabial tissue left with skin will, as I have seen in one case, leave a red brim along the line of union, necessitating a secondary operation for cosmetic reasons. (Figure 1.)

The length of the incision downward and outward depends upon the shape of the two portions of the separated lip. It is unnecessary at the beginning of the operation to estimate the length correctly, as the incision can be prolonged later on, after some of the sutures have been applied and tied, according to the requirements of the shape of the lip when united.

2. *Sutures of the Prolabium.*—Interrupted sutures of fine silk are applied or inserted from the mucous surface so as to place the knot of the suture in the mouth, the first suture close to the top of the triangle as shown in Figure 2. The ends of the sutures are left long and held together with an artery forceps which is left hanging down. The succeeding sutures are applied in a similar manner at a distance of from three to five millimeters from each other in a number corresponding to the extent of the line of prolabium to be united. These prolabial sutures should include the mucous membrane and sub-mucous tis-

sue only, or as little tissue as will suffice to keep the prolabial edges together. There must be no tension whatever at the line of union; if tension exists from shortness of the labial flaps, it must be overcome by the tension sutures, which will be described later.



Figure 1.



Figure 2.

When apparently a sufficient number of these sutures have been applied, they are tied from above downward, or from the nose to the prolabium, the upper or nasal suture first, the forceps being held up toward the forehead. The united line must be long enough to give sufficient length to the lip, and permit the lowest point union to be a little lower down (toward the lower lip), than the sides of the lip and the corners of the mouth. The wound to be united is now closed against the mouth—is made a sub-cutaneous wound.

Sutures of the Skin.—1. Tension Sutures. According to the size of the defect, one or two tension sutures become necessary. I have entirely discarded the figure-of-eight suture with harelip



Figure 3.

pins, and also the button and shot sutures, and always employ an interrupted suture, using silk a little heavier than that used for the coaptation sutures of the prolabium and skin. In ordinary cases of single harelip one tension suture is sufficient. This suture enters the skin at a distance of one-quarter to half an inch from the

cutaneous margin of the wound, and is passed deeply down into the tissue of the lip. Care is

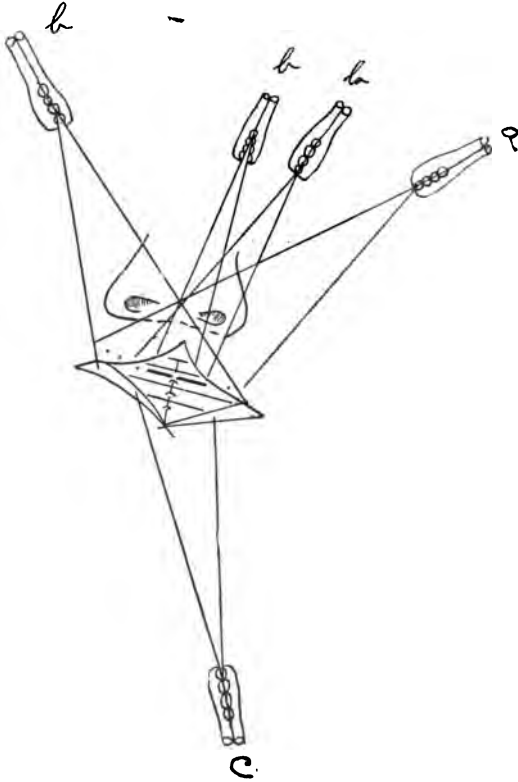


Figure 4.

taken not to have it pass through to the mouth, but to have it take in about two-thirds of the tis-

sue of the lip as shown in Figure 4 a. This tension suture should be placed at or near a point where the margins of the wound are the greatest distance from each other—that is, near to the prolabium of the undivided portion of the lip. The tension suture is left with long ends held by artery forceps, and should not be tied until all the cutaneous coaptation sutures have been inserted.

2. Coaptation Sutures. These sutures (Figure 4, b.b.b.), for which common silk twist (which may be bought in a dry goods store, and disinfected in the usual manner by boiling it from fifteen to thirty minutes in a 5 per cent. solution of carbolic acid) is used, are applied from above downward, or from the nasal angle of the wound to the prolabium, at a distance of three to five millimeters. Three to five sutures are usually required. The lowest suture (Figure 4, c.), is passed through the ununited borders of the prolabium.

The wound is now carefully cleansed by small aseptic sponges, and is finally touched with a sponge wrung out from $2\frac{1}{2}$ per cent. of carbolic acid, or a 1 to 2,000 sublimate solution.

If any hæmorrhage is present it can be stopped by continued pressure with an aseptic sponge for a few minutes; if the hæmorrhage is slight it will cease upon tying the sutures.

The closure of the sutures should begin with the tension suture, so as to prevent the coaptation sutures from tearing through, as they would

be liable to do if tied before all tension was done away with.

If in drawing the sutures together it is found that the middle of the lip does not come down low enough, or that there is still an indentation in the prolabium at the line of incision, it is advisable to prolong the cutaneo-prolabial incision a little on one or both sides, as the shape of the lip may require, and then apply an additional cutaneous coaptation suture.

When the cutaneous sutures are tied, the united wound should present the appearance shown in Figure 5.

4. *Dressing of the Wound.*—After careful cleansing of the line of the wound with saturated solution of boracic acid, a layer of finely powdered boracic acid is dusted on, and a cotton-collodion dressing applied. When I began to use this method I plugged the nostril with borated cotton, but on account of its inconvenience to the patient, have now discontinued this practice. I do not use iodoform-cotton or iodoform-collodion dressing for fear of iodoform poisoning; I prefer to have the nurse or mother dust finely powdered boracic acid into the nostril every three or four hours during the day.

A single or double strip of rubber adhesive plaster, extending from ear to ear, is applied over the collodion dressing in such a manner as to draw the two cheeks somewhat together, for the purpose of immobilizing the cheeks and lips when the child cries or nurses.

The dressing may be changed once a day, or every two or three days if it remains dry. If, however, the dressing becomes soaked by nasal secretion, or milk when the child is nursed, it should be changed according to the necessity of the individual case.

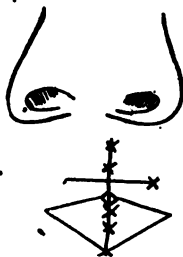


Figure 5.

5. *Removal of Sutures.*—The cutaneous coaptation sutures are removed after a week; the tension suture is allowed to remain two to four days longer if it has not been loosened by pressure atrophy, or pressure necrosis of its canal. After removal of the sutures, the borated cotton-collodion dressing and adhesive straps are re-applied to be continued until the suture canals have entirely healed, which takes place toward the end of the second or third week.

At the junction of the two lateral corners of the wound there often remains after the suturing a small quadrangular ununited space one to two millimeters in diameter, where it may have been impossible to approximate the edges of the

wound. (Figure 5 a.). A very fine suture may help to close this little defect. If, as is often the case, this little suture cuts through, the small defect heals by aseptic granulation, requiring only very little more time than the primary union of the remainder of the wound. It leaves at most a small cicatrix in the line of union at the border of the skin and prolabium, and does not result in permanent disfigurement.

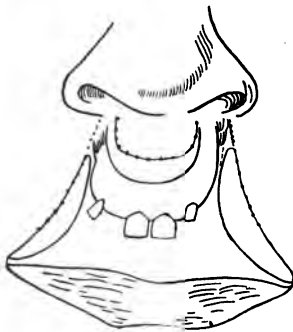


Figure 6.

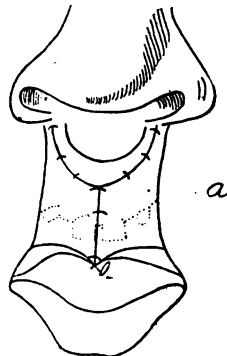


Figure 7.

The prolabial sutures will sometimes cut through and peel off if the process of healing goes on undisturbed, or some of the sutures may remain and be removed after the end of the second or third week, at a time when union is strong enough to tolerate the manipulations necessary for their removal.

II. OPERATION FOR DOUBLE AND COMPLICATED HARELIP.

The operation for double and complicated

harelip (as represented in Figures 6 to 9), is performed on the same general principles, namely:

1. *Incision.*—The incision along the cutaneo-prolabial border should be of sufficient length to cover the space of defect. A second incision should be made along the cutaneo-prolabial

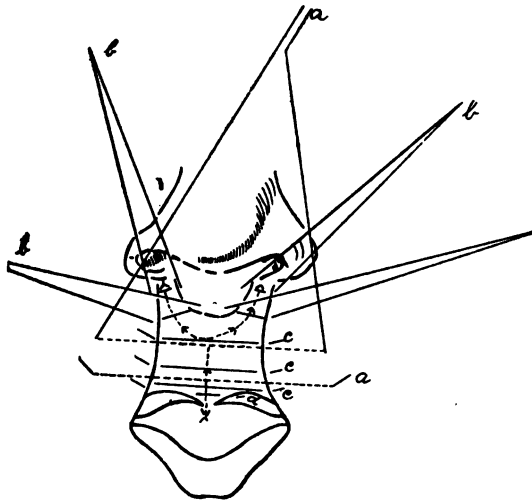


Figure 8.

border of the median peninsula of labial tissue below nasal septum, if this peninsula is so situated as to be available for use in the formation of the lip. (See Figure 6).

2. *Suture of the Prolabium.*—The prolabial sutures are applied as just described for the unilateral harelip, to be tied on the oral surface of the wound. The sutures should be first inserted

on both sides of the nasal peninsula until this is wholly covered, and until both lateral halves of the prolabium come together at the median point of its lower border. (Figure 7, a.). When this point is reached these two rows of sutures are tied.

The lateral prolabial borders are now united in the median line as low down or as far out as required to give to the lip the necessary length, as described in the operation for single harelip. These labial sutures are tied in the mouth usually without any tension, because the prolabium when loosened from the skin and retroverted, furnishes a flap of sufficient size and elasticity to permit of ready approximation.

It is important, as before stated, that the linear incision should not penetrate into the mouth. When, as is often the case when the cleft extends through the nostril or nasal cavity, there is a lack of prolabium near to and in the nostril, and the prolabial sutures cannot be applied high up, it is usually possible, by careful dissection and separation of the mucous membrane at the oral fornix of the lateral half of the upper lip, to displace the mucous membrane to some extent laterally, so that the uppermost suture may be applied reasonably high up toward the nostril.

When the prolabial sutures have been tied the wound presents the appearance represented in Figure 7.

3. *Sutures of the Skin.*—Tension and coaptation sutures are now applied as follows: (See Figure 8).

1. Tension Sutures.—For these sutures somewhat heavier silk should be employed. The upper suture should be inserted at the lower border of the nasal peninsula, the lower one near the lower border of the lip. They should be passed in and out at a distance of a quarter to

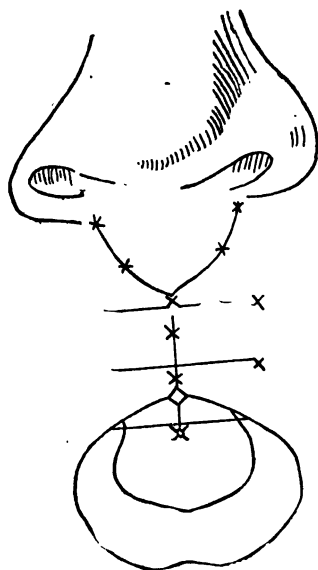


Figure 9.

half an inch of the border of the skin, and should include one-half or a little more than one-half of the thickness of the lip. (Figure 8, a.) The ends should be held by artery forceps, and should not be tied until all the skin sutures have been applied.

2. Coaptation Sutures.—The coaptation su-

tures (Figure 8, b. c.), are now inserted from above downward. The first two or three sutures (Figure 8. b.), are inserted on both sides between the lateral skin flap and the skin of the peninsula, until this is united to the side flap throughout its entire circumference. The lateral flaps, uniting in the median line just below the nasal peninsula, forms the upper portion of a Y-shaped line of union. Then the lower portion of the wound is united by two or three sutures (Figure 8, c.), and a lower fourth suture (Figure 8, d.) is inserted through the two halves of the prolabium.

After thorough cleansing and disinfection of the wound, the sutures should be tied : first, the tension, and then the coaptation sutures (Figure 7).

4. *Dressing of the Wound.*—The wound should be dressed with borated cotton-collodion, or in older patients, with iodoform-collodion. The nostrils, especially in older patients, should be loosely packed with borated or iodoform cotton. Over this two straps of adhesive plaster should be applied. In older patients a strip of iodoform gauze should be laid in the mouth along the line of union of the prolabium. In new-born children the nostrils need not be packed with cotton, and no iodoform gauze should be used ; but these localities should be frequently dusted with finely powdered boracic acid. The dressing should be changed according to the amount of discharge, never more than once daily.

5. *Removal of Sutures.*—The coaptation sutures of the skin may be removed at the end of the first week ; the tension sutures, according to the amount of tension remaining, usually late in the second week ; finally, what may remain of the prolabial sutures should be removed still later, when the union is so solid that the upper lip is able to tolerate manipulation.

It is immaterial how narrow the new upper lip may appear to be immediately after the operation. König remarks (in speaking on plastic operations on the lips—keiloplastic operations following the extirpation of labial carcinomas), that the shape of the mouth, however deformed it may appear, on account of unequal size of the lower and upper lip in the first weeks after the operation, that in the course of some months the shape of the oral orifice and lips becomes more normal, surprisingly so when a sufficient time, from three to six months, has elapsed.

The all-important feature of the operation is to make the upper lip long enough in a sagittal direction, and to have exact union of the lower portion of the prolabium.

Apparatus to draw the cheeks together for the sake of immobilization or to diminish tension, I have, up to this time, found superfluous.

CONCLUSIONS.

The two main points in this harelip operation are the incision and the prolabial sutures.

1. The incision, a linear incision, is similar to

that made in the operation for laceration of the perineum as proposed by Lawson Tait, and by him termed "flap-splitting." As stated above, this possesses the advantage of not sacrificing any tissue of the parts already more or less defective; on the other hand, repeated denudations made necessary by unsuccessful attempts at union would tend to make the lateral portions of the lip smaller and smaller. Furthermore, the linear incision, by loosening the everted prolabium (which is readily converted into mucous membrane by the simple change of position into the oral cavity), furnishes so much tissue for the posterior surface of the lip that union of the prolabial borders is easy, even before any tension sutures have been applied.

2. The prolabial sutures should be accurately applied. Fine curved needles should be used, the sutures made of fine silk. Interrupted sutures should be employed, in sufficient number and at sufficient intervals to furnish exact union. These sutures close the wound against the mouth and make the wound, so to speak, cutaneous instead of visceral, and thereby prevent infection from the ever-present multitude of microbes in the mouth. I believe that this suture will prove to be a potent factor in securing uniform results by preventing suppuration and non-union of the wound.

3. The cosmetic results have been all I could desire. If a slight indentation at the line of union of the prolabium has existed immediately after the operation, it has generally disappeared after a few months, provided the lip has been made long enough at the time of the operation.

4. I think that this method is applicable in all cases, and should take the place of all the numerous older methods of operating.

CADAVER STUDIES ON THE REMOVAL
OF THE SEMILUNAR GANGLION
THROUGH THE FLOOR OF
THE SKULL.

BY EDMUND ANDREWS, M.D., LL.D.,
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The horrible severity of pain in certain trifacial neuralgias is such as to drive the patient to the verge of suicide. Most of them are relieved for a period of one or two years by operations already well known, and a few are cured for life, but the majority relapse, because the neuritis has progressed to the semilunar ganglion, and hence nerve sections and stretchings below that organ relieve only temporarily. I have formerly shown that this relief can be repeated at least several times, by reopening the wound and pulling upon the cicatrix to which the stump of the nerve is attached, thus subjecting the stump and the ganglion itself to repeated stretchings, but I have little faith that the cure can be indefinitely repeated by this process.

I long ago concluded that the disease, in most cases, commences as a progressive neuritis excited by a decayed tooth, and extends upward into the ganglion itself, and hence that nothing less than the removal of the ganglion will effect a cure in the most obstinate cases. About a year ago, I commenced cadaver studies to see if I could devise any safe operation for the removal of the offending organ. It appeared six months later that Prof. Wm. Rose, of King's College Hospital, London, was independently considering the same question, and since that time he has performed the operation twice on the living subject, with success, thus fairly earning the credit of priority in point of time.

My experiments upon the cadaver, however, have interested me greatly, and throw much light on the best routes and methods of procedure. They also show that about six principal variations are possible in the plan of the operation. Cadaver studies are specially important, in this operation, because we cannot test and perfect the technique upon the inferior animals, since there is no species having a cranial anatomy near enough to that of man to answer the purpose.

The fifth, or trifacial nerve, emerges from the side of the pons Varolii as a rather large flat, striated band, and runs forward over the crest of the petrous portion of the temporal bone near the apex, where it enters an opening in the dura mater. This tough membrane, on the anterior slope of the petrous portion of the bone, divides

into two layers, and contains the ganglion between them, so that the latter is, as it were, encapsuled in a flattened cavity of the dura mater about the size and shape of a small Lima bean. The under side of the ganglion lifts easily from the floor of the capsule, having a bursa under it, an arrangement which facilitates separating it from the underlying carotid artery, but the upper surface is very firmly adherent to the roof of the capsule, so that even a curette can scarcely dislodge it. This arrangement adds greatly to the safety of the removal of the ganglion.

Out of this capsule the three branches of the nerve run, and the largest one, the inferior maxillary, passes downward and outward through the foramen ovale, and becomes the guide of the surgeon to the capsule of the ganglion. It is sheathed with a stout prolongation of the dura mater, which withstands pretty strong traction without rupture.

Besides several small twigs, the inferior maxillary divides into two main trunks, the dental and the gustatory.

The semilunar ganglion, or rather the under side of its capsule, lies in part directly upon the internal carotid artery where that vessel emerges obliquely from the petrous portion of the temporal bone, and its inner border is in close relation with the curve of the artery, where it enters the cranium, and also with the cavernous sinus, so that care must be exercised not to wound these vessels.

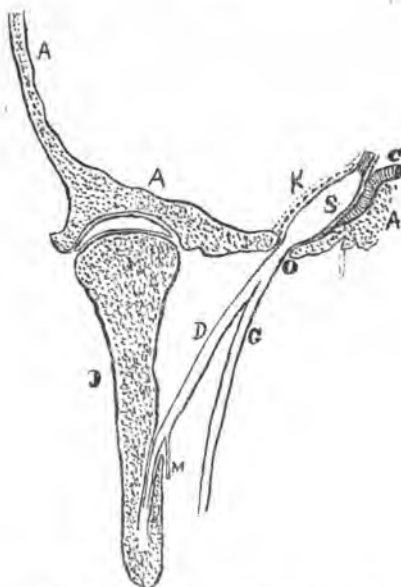


Diagram of part of the relations of the semilunar ganglion.

A A A.—Portion of skull.

J.—Condyle and ramus of jaw.

S.—Semilunar ganglion seen edgewise.

C.—Internal carotid artery.

K.—The double dotted line represents that layer of the dura mater constituting the roof of the capsule of the ganglion. The white line between the ganglion and the artery is the under layer or floor of the capsule.

O.—Foramen ovale at exit of inferior maxillary nerve.

D.—Dental branch.

G.—Gustatory branch.

M.—Myloid branch.

This cut is a diagram only, to show certain relations, and not a precise section.

The ganglion is therefore in a very inaccessible location, being inside the skull, near the centre of the cranial floor, and in dangerous relations

with great vessels—facts which have heretofore ruled it out of the field of operative surgery.

A closer study of the parts shows, however, that boldness and skill can storm the citadel. The point of approach must be at or near the foramen ovale, but in order to operate in such a location we must, by certain preliminary steps, uncover the parts, so as to see them with the eye, touch them with the finger, and attack them by a precise and unerring use of our instruments.

Fortunately, there are infallible landmarks to guide us to the foramen ovale, as a study of the topography will show.

My studies on the cadaver show the possibility of six forms of operation:

1. Prof. Rose's first operation, which was done by him six months ago. He uncovered the foramen ovale by excising the whole of one superior maxilla, thus getting at the parts from the front. He inserted the centre pin of a small trephine into the foramen, and took out a button of bone surrounding it, and contrived, through the opening thus made, to extract more or less completely the ganglion.

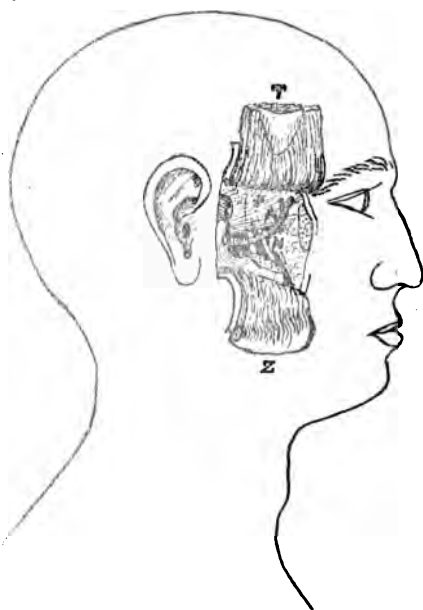
The patient's eye seems to have suffered some injury, for it became inflamed after the operation, and had to be enucleated, but the neuralgia ceased, and at the latest advices had not returned.

2. Rose's second operation was done last January. The method of uncovering the field of operation is very ingenious. Instead of removing the superior maxilla, two perpendicular incisions are

low the muscle, the large inferior dental nerve will be found, running down from the inner side of the muscle to the inferior dental foramen in the centre of the ramus of the jaw, and a little in front of it, the equally large gustatory branch, on its way to the tongue. These unite higher up into one trunk, which can be traced, with a little patience, up to the foramen ovale about $1\frac{1}{2}$ centimetres forward and inward from the inner border of the condyle of the jaw. By feeling for the sharp edge of the external pterygoid plate, and tracing it up to its junction with the base of the skull, it will be found to lead exactly to the anterior extremity of the foramen ovale, so that we have two guides to the orifice, the great nerve, and the sharp edge of the external pterygoid plate. If the external pterygoid muscle is thick and voluminous, it may become necessary to divide it near the neck and retract it with a suitable instrument, so as to uncover the foramen. The axis of the foramen has such a direction that a line drawn from the centre of the coronoid process upward and inward through the centre of the foramen, passes just beyond it into the centre of the ganglion itself.

The trephine is now applied, but owing to its position being oblique to the floor of the skull, the crown of the ordinary instrument strikes the bone, without the centre-pin being able to reach the foramen, and consequently the saw cannot be steadily worked. To overcome this, the centre-pin must be capable of being protruded 2 centi-

metres, and have the end round and blunt, instead of sharp, and be withdrawn as the saw progresses, so as to run no risk of entering the skull too far, which would endanger the carotid



View of relations of the nerves.

Z.—Zygomatic arch and masseter muscle turned downward.

T.—Temporal muscle and coronoid process turned upward.

P.—External pterygoid muscle.

N.—Inf. dental and gustatory nerves. Their continuation upward behind the pterygoid is intimated by dotted lines. The emergence of the common trunk from the foramen ovale is at the left of P. and covered by the muscle.

A.—Internal maxillary artery.

artery. The centre-pin is also made about one-half the diameter of ordinary centre-pins, otherwise it will be sometimes too large to enter the

foramen. As the crown of the saw advances, the pin is drawn back. Prof. Rose uses a trephine of $\frac{1}{2}$ inch inside diameter, like the specimen here shown. If this is done, it must not be advanced too far, otherwise the inner side of the crown will come directly upon the carotid artery, before it enters the cavity of the skull. When the inner half has cut a little way in, remove the button, and clear away needed portions of bone with other instruments.

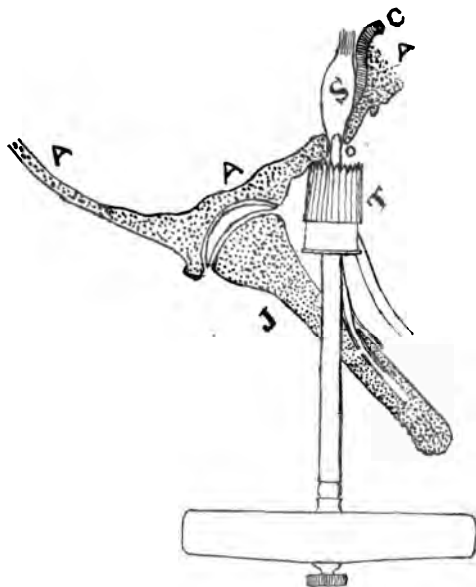
The extra length of shaft is to enable the handle to clear more easily the face and jaw, but still the ordinary length can be used.

The ganglion is in the bottom of the hole left by the instrument, and can be removed by curetting and by a small hook-shaped bistoury devised by Prof. Rose, assisted by a blunt hook. The carotid artery lies in contact with the ganglion on the face that looks downward, backward and inward—corresponding to the anterior slope of the petrous portion of the temporal bone. The vessel also curves around the upper and inner border of the ganglion directly in line with the axis of the foramen ovale, so that instruments must not be pushed too far in that direction, for if advanced too deeply, the crown of the trephine will cut the artery.

3. From careful dissection, and experimentation upon the cadaver, I am convinced that the following plan is better than either of the others:

Reflect the masseter and temporal muscles as before. Expose the external pterygoid muscle,

divide it near the condyle, and draw it out of the way with a suitable retractor. You now have a considerable area on the base of the skull, where there is no important organ to be wounded. This is a smooth triangle, having the pterygoid ridge



- A. A. A.—The skull.
 S.—The semilunar ganglion.
 O.—The foramen ovale.
 J.—The ramus of the jaw.
 T.—The trephine with the blunt center pin in the foramen.
 C.—The carotid artery.

of the temporal bone as its base, and its apex a little beyond and including the foramen ovale. One head of the external pterygoid muscle arises from this clear area, which should be dissected

up and retracted, or snipped out. This will give you a third guide to the foramen ovale, for if you clear away the tissues from the bone in a direction forward and inward from the inner border of the condyle, you will come unerringly, at the distance of about $1\frac{1}{2}$ centimetre, to the outer side of the foramen, which is an opening about $\frac{3}{4}$ of a centimetre in length, so that it need not be missed, even if the nerve had been torn or cut away by any accident. This clear space is over 2 centimetres in diameter, and affords abundant room for a 2-centimetre trephine, as shown at T, Fig. 2. Backward and outward from the posterior end of the foramen ovale, and at the distance of about $\frac{1}{2}$ centimetre, the middle meningeal artery enters the skull through the foramen spinosum, so that, if meningeal hæmorrhage occurs in the use of the trephine, it can be stopped by pressure of the tip of the finger at this point, or by ligature, or by plugging the foramen spinosum.

Also when the button of bone is withdrawn, the artery can be seized through the trephine



Curved and blunt pointed bistoury, modified from that of Rose.
hole, since it lies on the external surface of the dura mater.

Now apply a medium-sized trephine at the point marked with a black circle in Fig. 2, and carefully remove the included bone, setting the inner edge of the saw within 3 or 4 millimetres

of the outer edge of the foramen ovale. Next take a narrow guage forceps and nip away first the isthmus of bone between the trephine hole and the foramen, and then, drawing the nerve outward into the trephine hole, nip away the inner border of the foramen. By a good artificial or natural light, you now see well exposed a pretty large ovate area of dura mater, with the large inferior maxillary nerve emerging from its further portion. The sheath of the nerve here is very strong, so that it can be freely pulled during the further manipulations. Now peel up the dura mater from the floor of the skull under the ganglion, going a few millimetres beyond the locality of the foramen ovale. This lifts the ganglion with the membrane, it being included between the two layers. Next seize the nerve, or the stump of it, near the opening, with narrow forceps, and draw it outward. Dissect off the dura mater from its posterior or further surface of the insertion of the nerve, and you will come into the capsule and the bursa between the gland and the floor of the capsule. Extend the opening of the capsule to the right and left somewhat freely, and with a careful use of Rose's knife or a very small blunt-pointed and curved bistoury, divide the origin of the superior maxillary nerve, and if possible of the ophthalmic branch. The latter lies very close to the cavernous sinus.

Now have an assistant lift the dura mater, while another one draws the nerve inward, and you will be able to open the dura mater and very slowly to

dissect the ganglion away from its firm adhesions to the roof of the capsule. This dissection is a little tedious, on account of the firmness of the adhesion, but patience will accomplish it, and if one or more slight cuts occur through this upper layer of the capsule of the dura mater, no dangerous results will follow. Indeed, it might perhaps be well to take curved scissors, and cut out a small circle of the roof of the capsule and take it away with the ganglion, thus shortening the operation. This operation admits of splendid illumination, and enables one to see clearly the steps of the dissection.

4. A fourth method is possible on the cadaver, but less easy than the third. It is to commence as in the previous operation, but to set the centre-pin about a centimetre farther out on the pterygoid ridge, and remove a large button of bone. Then raise the dura mater from the floor of the skull, working inward until the ganglion is lifted and the finger feels a large probe inserted into the foramen ovale. Now open the capsule and patiently work out the ganglion, guided by feeling rather than by sight.

5. A fifth plan can be carried out as follows: Leave the zygoma and the coronoid process untouched. Raise a semicircular flap of scalp and temporal muscle from the temporal fossa in such a way that a large trephine can be set on the bone, with its lower edge close down to the zygoma, much as in Stephen Smith's operation for tying the middle meningeal artery inside the

skull. Remove the button and, making a flap in the dura mater, insinuate a peculiarly shaped curved spatula under the convolutions of the brain, and lift them from the floor of the middle fossa. The ganglion lies on the anterior slope of the petrous portion of the temporal bone, with its lower edge about $2\frac{1}{2}$ centimetres from the lower edge of the trephine hole. Pass in the finger under the arch of the spatula, run it along the petrous portion to identify the locality of the ganglion by its softness. Withdraw the finger, throw in a strong light, dissect out a circle of the roof of the capsule of the ganglion, and use the hook-shaped bistoury, bent scissors and curette to sever other attachments.

This plan temporarily compresses the brain, and makes some unavoidable contusions and slight wounds of the convolutions, but it is not very difficult. It would be doubtless more dangerous than either of the others, and therefore is not to be preferred in our present state of knowledge.

6. The sixth and last method is to make an incision from the anterior edge of the temporal muscle down to the anterior slope of the coronoid process, and saw off the anterior end of the zygoma. Next saw off the posterior end through a small opening in the skin. Then saw off the ramus of the jaw from the middle of the anterior slope of the coronoid downward and backward to near the angle of the jaw. Raise this flap of skin, muscle and bone as on a hinge, and turn it back over the ear. My first hope was to uncover the

deeper parts in this way without sacrificing any bone, but the result was to pry the condyle of the jaw inward, bulging the external pterygoid before it, and effectually covering the foramen ovale from sight; hence, if this plan is adopted, it is necessary to exsect the condyle, draw away the external pterygoid, and divide part of the internal pterygoid, in order to follow the inferior maxillary nerve into the foramen. This and the plane surface of bone external to it being thus exposed, the operation is finished either as in No. 2 or in No. 3. The loss of the condyle is an objection in this case, just as the loss of the superior maxilla is in No. 1. On the whole No. 6, though mechanically feasible, cannot be recommended.

Of the whole six, I give the preference to the third, which uncovers the parts as in Rose's second operation, but applies the trephine at a different spot.

In the two cases operated on by Prof. Rose, the first lost the eye by inflammation following the operation, due perhaps to accidental injury at the resection. In the second case the professor informs me that the eye, three months after the operation, was in good condition, and was recovering its lost reflexes. Both patients were relieved of their pain, thus far, but more time must elapse to demonstrate the permanency of the cure.

As the eye is deprived of sensation, the patient must be taught to care for it and protect it. In the same way one side of the tongue being be-

numbed, it must be guarded from being wounded by the teeth.

A neurotomy of the fifth nerve on the proximal side of the ganglion can be performed, without removing the latter. If you proceed as in operation No. 3 till the button of bone is removed, and then open a flap in the dura mater external to the ganglion, the convolutions can be lifted, and a knife with a double curve and blunt point can be passed over the crest of the petrous portion of the temporal bone, and made to cut the nerve where it enters the capsule of the ganglion. This operation is possible, but does not seem advisable. It is not best to replace the button of bone in these cases, because a certain portion of such pieces necrose, and the deep location renders the subsequent extraction of the dead fragment difficult.

On the whole, the removal of the semilunar ganglion is a slow and rather complicated operation, but it is not very dangerous. It is to be employed without hesitation whenever a trifacial neuralgia is so severe and so incurable that the patient has no reasonable hope of relief from extreme pain by other measures.

Time only can show how many will be permanently cured. From the nature of the case we should expect that the cured cases would be a large majority, but that in a few the brain itself may be the seat of disease, and baffle our efforts. If the brain is the seat of the trouble, we can usually determine it by the coincident presence

of other cerebral symptoms, and thus avoid operating upon hopeless cases.

In making these researches upon cadavers, I am indebted to Profs. Wyllys and Frank Andrews for valuable assistance.

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SPRAINS OF THE ANKLE.

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There is a popular impression among many of the laity "that a sprain is worse than a fracture," yet, to judge from the amount of space devoted to the subject in our text-books on surgery, it is evident that their authors do not agree with the statement. We must, however, admit that some grounds exist for the belief, and that, while we seldom hear of an ununited fracture, or of a fracture causing trouble years after the original injury, we are constantly meeting with cases of chronic sprain of the ankle, of flat foot, of various forms of bone and joint disease which we can clearly trace to a sprain. Several reasons exist for this state of affairs, and in many instances, the reason may be clearly shown to be the faulty or neglected treatment of the original injury.

Mr. Mansell Moullin, of London, in his most thorough and interesting monograph on "Sprains; their Consequences and Treatment," says in his

Introduction: "Few injuries are treated with so little consideration as sprains. It is impossible to overlook wounds, owing to the bleeding and pain which accompany them. Fractures, it is understood, require rest and care; but sprains, in which the tissues are torn to such a degree that the damage is far more serious than in many fractures, merely because they are so common, are considered of little or no consequence. It counts for nothing that the part injured is one of the most complicated structures in the body, and particularly liable to inflammation from the constant use to which it is subjected. Yet a fracture is regarded as very serious, a sprained joint as quite a trivial matter." Other authorities could be quoted to show that sprains in many cases receive little or no treatment; the patient is dismissed with the statement that it is only a sprain; bathe it in hot or cold water, or rub a little arnica or Pond's extract on your ankle. Nothing more is thought of the case, and years afterwards, the original injury having almost been forgotten, the sufferer applies to some specialist for treatment.

This state of affairs is very graphically described by Royal Whitman, M.D., in an article read before the American Orthopædic Association in 1890, on "The Treatment of Persistent Abduction of the Foot, commonly known as Chronic Sprain of the Ankle." He says: "The successful treatment of any chronic affection demands a personal, persistent attention to details on the part of the surgeon. This is particularly

true of the treatment of what are known as minor injuries, and therefore neglected. One of this class, commonly known as chronic sprain of the ankle, may entail years of discomfort and disability, with permanent impairment of the functions of the foot. The usual history of such cases is as follows: Long-continued weakness and discomfort, following an injury to the ankle, treated by various physicians with liniments, blisters and bandages, until the discouraged patient is told that nothing more can be done, but that his symptoms 'will wear away in time.' A year or two later he presents himself, usually for the purpose of securing a brace, or for some peculiar shoe which he thinks may be of service to him."

I have quoted thus at length, because it is my firm belief that most of these disagreeable after-effects can be avoided, if the patient and surgeon will simply recognize the fact that every sprain, no matter how trivial, is worthy of treatment.

The prevention of a flat foot is easier and more satisfactory than its treatment, and a large number of the cases have their origin in a simple and neglected sprain of the ankle. The same is true of bone lesions, and if the injury is recognized, and its importance admitted, many cases will thus be saved from the unpleasant symptoms, so common, as the result of the practice of considering sprains as slight and unimportant injuries.

The definition of a sprain as given by Webster

—the weakening of the motive power of a part by sudden and excessive exertion—describes both the manner of production of the injury and the result produced, but a more accurate and better definition is that given by Mr. Edward Cotterell, in his little book on "Some Common Injuries to Limbs." He says: A sprain includes all injuries to a joint and its surrounding structures produced by a sudden twist, but stopping short of dislocation.

Many degrees of severity may exist, and the classification adopted by S. L. McCurdy, M.D., in an article on "Sprains and their Treatment," which appeared in the *Columbus Med. Journal* for January, 1891, is a very good one.

He divides them into three classes. In the first there is simply a contusion of synovial membrane and a stretching of the soft parts; in the second there is a rupture of the ligaments and synovial sac; and in the third "sprain fracture"—the ligament, instead of tearing, pulls off a thin layer or slice of bone. This accident, though infrequent, perhaps might best be considered under the head of fractures.

A better method of studying the cases, seems to me to be that adopted by Mr. Moullin in the monograph previously alluded to, and its perusal will repay those interested in the subject.

He discusses the effect produced on each tissue by such injuries, and the mutual sympathy of all the parts. The ankle-joint is particularly liable to sprains, its normal movements being flexion

and extension, in alighting upon uneven surfaces, whether from a height or from some moving body, as a car, wagon, etc., unless the foot is evenly placed, the weight of the body being suddenly thrown on the joint, causes the foot beneath it to twist, and a violent wrench or sprain ensues. Severe pain is felt, in most cases limited to the parts near the ankle, in other cases extending up the limb. In the most severe cases, a condition of shock may even result, and the entire nervous system apparently becomes deranged.

Moullin says: The pain when ligaments are torn is usually described as sickening in character, and those who have once felt it, rarely fail to recognize it a second time. If a muscle is strained, there is generally a peculiar sensitiveness of the skin, most marked over its points of attachment to the bones or tendons. Slight touching of the part may cause exquisite pain, yet firm pressure may be well borne.

When the muscle is torn across, either partially or wholly, there is a sharp pain, like that of a blow with a whip or a cricket ball, so that the patient may turn around to see who has struck him before he is aware anything has given way; and then, as the swelling begins, this is followed by a feeling of stiffness and soreness, severe even when the limb is at rest, but so much worse when an attempt is made to use it, that the patient can often hardly be induced to try. Similar pain occurs when a muscle is dislocated, and after the restoration there remains a sensation of soreness,

with a tender spot corresponding to the slip displaced. These tender spots may remain for a long time in the ankle, if a lateral ligament has been torn away from the bone—but allowance must be made for those that are normally present when a joint is hurt. What they are caused by is not always certain, but as a rule they correspond to points where the capsule is thin and flexible and not far removed from the surface, so that pressure falls directly on it. At the ankle there is generally one on the front of the joint, rather to the outer side of the middle line.

Swelling more or less severe follows. The joint may become distended with synovial fluid, or blood may become extravasated into it. The appearance of the swelling may be very rapid, in many cases extreme, and followed by inflammatory symptoms—increased local temperature and redness, later on perhaps followed by an increase of the body temperature, if the inflammation be very severe. Motion of the affected joint may be slightly diminished, or even entirely lost, spasm of the muscles in proximity to it occur, and motion is thus limited, or the patient may voluntarily contract the muscles, from fear of being hurt, and thus produce spasm. Staining occurs at or near the site of injury, due to the extravasated blood, the color varying according to amount extravasated and the time it is seen after the infliction of the traumatism. If the bursa is injured, a teno synovitis or bursitis may follow, characterized by the presence of fluid in the bursal sac,

and in some cases, later on, by adhesions. The close resemblance of these sprains to many dislocations is clear when we recognize, as was done by Vidal de Cassis, that they are really the same thing, only that reduction has taken place spontaneously.

Having thus briefly considered the pathology and symptoms, the question of treatment should not be a difficult one.

If we recall the anatomy of the ankle, we find that it is superficial, not covered with much fatty or muscular tissue, surrounded by ligaments and tendons, and that the latter have reflections of the synovial-like membranes from their sheaths, forming bursæ. The indications are to give the injured parts support and rest, restore the joint functions and prevent inflammation.

It is of course understood that a careful differential diagnosis must be made. The sooner the case is examined after the injury the better. Fractures and partial dislocations, bone or joint disease, must be carefully excluded.

If any doubt exist, give the patient the benefit of that doubt. Do not hesitate to give an anæsthetic if, for any reason, careful and satisfactory examination cannot be made without it. This is of great importance from a medical as well as a legal standpoint, as a case of Pott's fracture or fracture of tibia, fibula or tarsal bones, if treated as a sprained ankle, might cause serious trouble. These mistakes should and can be avoided. When the lesion has become chronic, the diagnosis is

often difficult, and bone disease is easily mistaken for chronic sprain of the ankle, but we are supposed to be dealing with the acute or recent cases. How best to fulfil the indications of treatment depends somewhat on the individual case and the facilities at hand. Rest of the part with preservation of its function, seems to me best accomplished by means of a dressing of adhesive plaster which I call the Cotterell dressing, as Mr. Cotterell was the first to use it in sprains of the ankle, although the idea was suggested to him by Mr. Wharton Hood (*Lancet*, Vol. ii, 1884, p. 728), for the treatment of what is known as lawn tennis leg. The limb is elevated, to assist in reducing the swelling, then strips of adhesive plaster, each $1\frac{1}{2}$ inch in width, and of the length adapted to the foot and ankle joint, are applied, somewhat as strapping is applied in the treatment of chronic ulcers of the leg. It is not advisable to use strips narrower than one inch, as they may cut the parts by a curling up of edge of the plaster. Over this a firm roller bandage is applied, and the patient is directed to get up and walk. The adhesive plaster causes a firm and even compression of the parts, acts as a light splint, prevents exudation and permits motion, which in the mild cases is desirable. The patient may come into the office limping and heavily leaning on a cane, and yet after the application of this dressing, if he is once persuaded that motion will not injure his joint, he is enabled to dispense with the cane, and in a short time walk with comfort.

In one case a policeman weighing 280 lbs., although he had not stepped on his foot for three days after a severe sprain of the ankle, was enabled to return to duty within six hours after its application. This treatment is recommended where the injury simply consists in a wrenching of tissue and a contusion of synovial membrane.

In the more severe injuries, when ligaments are torn across, muscles ruptured, synovitis or bursitis present, the parts should be strapped, and then foot and ankle encased in a plaster of Paris or silicate of soda splint. Care should be taken that the foot be put up at a right angle with the leg, and in a position of varus, not of valgus. The strapping in all cases should be renewed in a few days, as, when the swelling subsides, it becomes loose. The plaster of Paris must not be left on too long, as when acute symptoms subside motion is desirable, to prevent adhesions and stiffness of the joint. If extreme swelling or inflammation have occurred before case is seen, then heat, cold, the various antiphlogistics, may be used, and after these massage and electricity. Support is needed as long as there is swelling or marked tenderness.

It is not intended in this paper to discuss the subject exhaustively, but rather to call attention to the fact that sprains of the ankle, even of slight degree, are worthy of careful treatment, and that, in my opinion, the Cotterell dressing is the best form of treatment in the mild cases, and the Cotterell dressing and plaster of Paris in the more severe.



THE RELATION OF CALCULI TO MALIGNANT DISEASE OF THE LIVER AND KIDNEYS.

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Since it has become the established surgical method to explore the abdomen in case of doubtful diagnosis, we have definite scientific knowledge, which can often be used for the well-being and safety of the patient while alive, instead of merely adding to our stock of post-mortem information. Among other beneficent results to which we have fallen heir is the improved surgery of the liver and kidneys. In the performance of these operations, many surgeons have noted the frequency of the correlation of biliary and renal concretions with malignant disease. The following case will illustrate the subject to which I desire to direct attention in the present paper.

Mrs. —, age 65, had from time to time for six months before my attention was called to the case, attacks of biliary colic. Her physician had

given the usual treatment, such as olive oil, etc., with the alleged result of causing the evacuation of several "rather soft" gall-stones. (I have never had any reason to think olive oil any better drug than any other substance capable of being saponified, or otherwise causing fatty or soapy masses to pass per anum resembling gall-stones).

At last, after much delay, and the advent of grave symptoms of collapse, the patient was referred to me for operation. There was slight jaundice, the urine highly colored with bile, and the usual stools seen where there is absence or deficiency.

There was some enlargement of the liver just over the gall-bladder, and some emaciation of the patient. Diagnosis, gall-stones, with probable malignant disease. The operation was a very simple one. As soon as the peritoneum was opened, and before a sponge could be securely placed in position, an abscess opened and poured out two or three ounces of offensive pus. The malignancy was beyond doubt, and quite a number of gall-stones were quickly removed, although no time was lost in searching for them. The peritoneum was stitched to the abscess wall, thus securing the peritoneal cavity from infection for the time, and a drainage tube and dressing completed the operation. The patient was quite comfortable after the operation, not even requiring morphia, as she had done previously. She lived very comfortably for three weeks, and died of uncontrollable hæmorrhage from a vessel

deeply seated in the liver. This case, and several autopsies where a similar condition was found, have led the writer to a study of these phenomena, and the points at issue are these :

Are calculi a cause of malignant disease, or are they a result ?

Is their presence merely a coincidence ?

Or are calculi very often present without giving rise to symptoms, or disease, and only found post-mortem ?

It is quite possible that vague and indefinable symptoms, very often reflex in their manifestations, leave us in doubt as to their significance.

That there is an element of truth in all these statements is beyond question. It has been shown by several authorities that the kidney is not so frequently invaded by malignancy as a result of calculous disease as is the liver. For instance, Ralfe gives "renal calculi" a cause of cancer, "as we often find renal concretions in cancerous kidney, though it is certainly not such a frequent clinical sequel as is the case in biliary disease."

A clinical instance is given by Dr. Norman Moore (*London Path. Soc. Rept.*, 1882) ; also an instance by Mr. Pollard in same *Trans.* for 1885 (*Ralfe, Dis. of Kidney*).

In *St. Bartholomew Repts.* we find, Vol. XXI, a case reported of nephrolithotomy for calculous pyelitis, and after death not only an abscess, but epithelioma, was found, which was produced by

the irritation of the calculus (*Newman, Surg. Dis. Kidney*).

The writer has notes of one case of chronic Bright's disease in which, at the autopsy, several calculi were found in one kidney. No positive symptoms of stone were recognized during the patient's life.

Dr. Bright early recognized the coexistence of renal calculus and cancerous disease. One report shows the finding of a lactic acid formation in one kidney, and an oxalic stone in the other.

Another case mentioned by Brodeur (*p. 170, Newman's Dis. Kidney*): A female, æt. 36. R. Kidney tumor removed by abdominal method. "Patient died in two days. Weight of tumor, 1 lb. Pelvis and calices contained calculi, although the microscopist said the disease began in the epithelial lining of the renal tubules." Epithelioma appears to most frequently follow this form of irritation; at least, more frequently than other forms of cancer.

If evidence is given that the kidney is probably the seat of cancer as a result of calculous irritation, we are abundantly able to show that the liver is much oftener attacked by malignant disease than these organs. In Guy's Hospital Reports for 1875, Dr. Hilton Fagge reports forty-two autopsies, covering a space of fifteen years, showing an intimate correlation of calculi and carcinoma. He says: "But the way in which death is most frequently brought about in persons who have gall-stones is by the development

of cancer about the gall-bladder or the bile ducts. Within the period of twenty-one years already referred to there have been at least twelve cases in which gall-stones being present, there has been likewise malignant disease of these structures. In some instances, the clinical history has pointed distinctly to the view that the jaundice was originally due to an ordinary attack of biliary colic, and that the development of cancer was secondary. Indeed, one case seems to admit of no other interpretation. (The case is given at length.) But in the great majority of cases in question, no gall-stone has been impacted in the duct at the seat of the cancer. The concretions have been found in the gall-bladder itself, which has often contracted round them, and empty, or containing only a little purulent mucus. Thus it appears probable that if the malignant growth had not developed, all the symptoms would have subsided, and the health of the patient would have been restored. All observers, indeed, are not agreed that the cancer of the bile-ducts arises secondarily when it is found in association with gall-stones. It has been urged that the gall-stones are often discovered in the bodies of those who have died from cancer of the breast or of other organs. This may be merely a coincidence, for both cancer and gall-stones are especially apt to occur in persons advanced in life. However, even if some deeper relation than at first sight appears probable should be proved to exist between the formation of biliary calculi and the

development of cancer in the body generally, this would not do away with the clinical significance of the facts stated above; it would still remain true that when a patient who has had attacks of biliary colic dies of protracted jaundice, the ducts are almost invariably found to be affected with cancer." . . . "Statistics show the jaundice as a symptom of cancer is just twice as frequent as owing to gall-stones." Dr. Markham (*Harley, Dis. Liver*) reports a case which was supposed to have been pyloric disease. Patient, age 28. Intense jaundice; pain; vomiting after eating; urine deeply colored with bile; no bile in stools. At autopsy the gall-bladder was found converted into a large and solid mass of scirrhus, which commenced in the coats of the viscus itself. In the center of the mass was found a number of gall-stones, which were supposed to have to do with the formation of the cancerous deposit.

Dr. Coupland (*Trans. Path. Soc., Lond.*) reports another case in a woman, æt 56. A large number of calculi were found in the center of a malignant tumor. Dr. Harley mentions another case reported by Dr. Norman Moore, occurring in a woman aged 59. One case appears to have been attributed to the operation of gastroenterotomy.

Harley says (*Dis. Liver*): "The liver and gall-bladder are alike subject to irritation and cancer resulting from gall-stones. Gall-stones apparently, indeed, not only give rise to serious organic changes in the wall of the viscus, such as inflam-

matory thickening, and hypertrophies, but to the formation of new growths in the shape of benign, scirrhus and malignant encephaloid tumors." After mentioning a case of acute yellow atrophy of the liver, associated with biliary calculi, Murchison says, p. 271, ed. 1877: "It is remarkable that most of these cases (alluding to secondary cancer of the bladder from extension of the disease from liver and pancreas, more commonly commencing in the gall-bladder, and secondarily affecting the liver and peritoneum), the gall-bladder contains calculi, and the cancer appears to be the sequel of gall-stones. Not infrequently there is a history of biliary colic. (P. 372). The passage of a gall-stone, with or without hæmorrhage from the bowels, concurring with a tumor, would corroborate rather than refute the diagnosis of cancer." Murchison gives histories of cases in support of this opinion. These cases support the view announced by Dr. Fagge, "that there is frequently a history of biliary colic preceding the onset of cancer."

Authorities differ greatly upon the question of the relation of carcinoma to gall-stone formation. Until recently, most observers were inclined to look upon the cancer, or the cancerous diathesis, as the cause rather than the effect of the calculi. Several recent clinical observations would appear to confirm the belief that calculi may be the irritating cause in some cases. Quetsch (p. 39) relates the history of a female patient who had a biliary fistula opening upon the surface, the

result of a long-standing calculous disease. Some of the calculi did not pass through the fistula, and carcinoma of the gall-bladder, which developed, was attributed to the irritation produced by their presence in the organ. The article in *Buck's Ref. Hand-book Med. Sci.* clearly favors the above view. Frerichs notes the coincidence of cancer of the biliary system and calculi, having, in eleven cases, found calculi nine times. This subject has claimed some attention from clinicians and pathologists for many years, but there are few, if any, authors who have attempted to collect a résumé of the literature of the subject.

Dr. Arthur Willigh (*Virchow's Arch.*, 1869) reports one case. A writer in the *Bullettino delle Scienze Mediche di Bologna*, 1871, adds his voice in favor of the above views, and gives a case occurring in a woman aged 48. Dr. Kraus, of Carlsbad, mentions a case of primary cancer of ductus cholodochus produced by the wedging of several stones in the canal. (*Prag. Med. Woch.*, 1875.) Dr. Harley mentions one reported by Dr. Vanderbye. (*Path. Soc. Trans.*, 1858.) A woman, age 64, having extreme liver disease of malignant character, with neither jaundice nor anasarca, and with forty gall-stones in her gall-bladder.

The fixed idea that injuries of the liver may cause the development of cancer, if true, gives color to the possibility of cancer being caused by calculi. Harley strongly presents this view, that

either injury or irritation of the nerves or tissue of the liver is a far more frequent cause of its malignant degeneration than the majority of physicians suppose. Just here I would mention that, as it is generally supposed that jaundice is nearly always present in malignant disease of the liver, statistics seem to show that in only a small proportion of all cases is it present save in last stages of the disease. It is also further worthy of remark that many cases of gall-stone are present with jaundice without cancer in proportion of two to one. Among American writers I find but little said upon this subject. Dr. Ransdorf and Dr. Musser, of Philadelphia, are exceptions; both indorse the views of authorities quoted in this paper. In closing, I do not think it important to comment upon the remaining phases of the question as to the cause of cancer, as, for instance, the cachexia of cancer favoring the formation of gall-stones. The study of reported cases shows plainly the deposit of cancer formation as a result of mechanical irritation, of which there are instances in other parts of the body. We have not lost sight, however, of the possibility of cancerous obstruction adding to the possibility of calculous formation, although we incline to the idea that the slow formation of calculi must date far beyond the period when the fatal obstruction from cancerous deposit occurs.

(*Note*.—Since the meeting of the Association, the following notes have been prepared, to be added as a postscript) :

W. H. Larmond, in *Le Prog. Medical*, 387, 1882, reports a case of biliary calculus, grave icterus, and cancer of the liver. Patient's age, 75. Several calculi size of filberts.

H. Zenker, *Deut. Arch. f. Klin. Med.*, Band xiv., says of the method of transformation to cancer: "The malignant process in these cases starts in much the same manner as does a cancer of the stomach from the edges of a benign ulcer." Zenker was able to find, on microscopic examination, that cicatrices of the gall-bladder, caused by the presence of gall-stones, were accompanied by an outgrowth of epithelium not only from the gall-bladder, but in the adherent parts, such as the transverse colon, or the common bile-duct. Where the points of transmission lie between such a typical epithelial growth and the commencement of actual cancer it is not possible to say. The author holds that the passage from one to the other is gradual, and that old age is a predisposing cause.

In *Trans. Med. Soc., Lond.*, vol. xli., 1889-90, p. 40, Dr. H. Handford communicates an interesting history of a female patient, age 55, who had cancer of the portal fissure of the liver, jaundice, impacted gall-stones, combined with interstitial hepatitis (atrophic cirrhosis). Very many gall-stones were found in this case. The points of special interest were these :

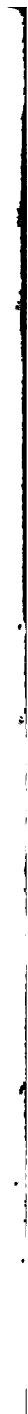
1. The association of carcinoma with impacted gall-stones. The author well says: "This is

not very rare, although not so common as the association with non-impacted stones."

2. The presence of multiple strictures of the intestine. Neither excision of the rectum or inguinal colotomy would have given much relief in this case, because of the obstruction higher up.

3. The association in the liver of interstitial hepatitis with disseminated carcinoma.

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SUPRA-PUBIC CYSTOTOMY.

BY JOHN A. WYETH, M.D.,
OF NEW YORK.

The personal experience upon which this report is based embraces twenty-three operations, in all of which recovery ensued. They may be, for purposes of study, divided into :

1. Tumor of the bladder 6 cases.
2. Tumor of the bladder, with stone . . 2 “
3. Stone (without tumor) 3 “
4. Foreign body 1 case.
5. Cystitis, without tumor, stone or foreign body (one case with fistula) . 11 cases.

23 cases.

I. TUMORS.

Case 1.—Male, aged 40. Operation July 7, 1888. Seven months before, hæmaturia, chills and fever. Diagnosis, cancer of bladder. Large epithelioma removed. Drainage tube removed eighth day. Urine ceased to escape through wound on sixteenth day. Recovery. Improved. Six months later, death from general metastasis and exhaustion.

Case 2.—Male, 36 years old. Operation July 20, 1888. Small benign sessile tumor removed

from floor of trigonum. Drainage tube removed sixth day. Wound closed on eighteenth day. Recovered. Cured.

Case 3.—Female, 20 years old. Small, pedunculated, benign tumor at commencement of urethra, forming ball-valve, and stopping free outflow of urine. Operation March 26, 1889. Wound in bladder closed at once. Catheter per urethram ten days. No leakage. Recovery.

Case 4.—Male, 54 years. Operation October, 1889. Tumor of bladder just behind urethral opening removed (third lobe of prostate). Drainage for eight days, and wound closed. Recovery.

Case 5.—Female, 42 years. Operation December, 1889. Valve-like fold of hypertrophied or thickened mucous membrane partially closing outlet of bladder. Removed. Wound in bladder closed at once by suture. Recovery. Cured.

Case 6.—Male, 62 years. General hypertrophy of prostate, enlargement of middle and both lateral lobes, chronic cystitis for three years, and with partial paralysis of bladder from over-distension. Operation November 12, 1890. Recovered, much improved. Permanent drainage necessarily established.

2. TUMORS COMPLICATED WITH CALCULUS.

Case 1.—Male, 67 years. Operation September 4, 1888. Tumor of prostate and calculus removed. Tube removed sixth day. Wound closed by sixteenth day. Recovery. Cured.

Case 2.—Male, 48 years. Operation Septem-

ber, 1889. Tumor and calculus removed. Drainage for about ten days. Recovery. Cured.

3. STONE UNCOMPLICATED EXCEPT WITH USUAL CYSTITIS.

Case 1.—Male, 46 years. Operation September 28, 1888. Large stone removed. Tube discontinued eighth day. Fistula persisted for four weeks. Scraped this out and it then closed. Recovery. Cured.

Case 2.—Male, 60 years. Operation December, 1889. Piece of catheter four inches long, thickly incrustated with urine salts, removed. Tube discontinued fifth day. Recovery. Cure.

Case 3.—Male, 16 years. Operation March 9, 1890. Oxalate of lime stone about one inch and a half in diameter removed. Drainage five days. Wound closed on fifteenth day. Recovery. Cure.

4. FOREIGN BODY (UNCOMPLICATED).

Case 1.—Male, 41 years. Operation July 25, 1888. Piece of metal catheter removed. Tube discontinued fifth day. Wound closed fourteenth day after operation. Recovery. In this case, immediate suture would have been permissible.

5. CHRONIC CYSTITIS WITHOUT TUMOR OR STONE.

Case 1.—Male, 40 years. Operation December, 1888. Drained three weeks. Wound closed gradually. Recovery.

Case 2.—Male, 68 years. Old persisting fistula from former operation with cystitis. Fistula

opened up; scraped out; wound allowed to close. Recovery.

Case 3.—Male, 54 years. Cystitis after previous operation. Usual drainage. Recovery.

Case 4.—Male, 4 years. Cystitis, with paralysis due to compression of cord. Tube removed fourteenth day. Wound closed gradually. Recovery.

Case 5.—Same patient. Drainage reëstablished by operation, and prolonged. I opened the spinal cord, evacuated abscess of the cord, and cured the paralysis in this case. Recovery.

Case 6.—Male, 24 years. Cystitis for eighteen months. Operation March 14, 1890. Drainage three weeks. Recovery.

Case 7.—Male, 36 years. Cystitis for one year. Operation March 28, 1890. Drainage two weeks. Wound closed in four weeks. Recovery.

Case 8.—Male, 58 years. Impermeable stricture of urethra and cystitis. Drainage for six weeks. Patient had cerebral hæmorrhage, and died eight weeks after the operation from compression of brain. Cystitis was cured at time of death.

Case 9.—Male, about 45 years. Complete paralysis of bladder, and cystitis. Permanent drainage. Recovery.

Case 10.—Male, 59 years. Chronic cystitis and neuralgia of the vesical neck and prostate. Operation January 28, 1891. Drainage tube removed fourteenth day. Small area of thickened

mucous membrane over trigonum removed. Wound closed gradually. Cystitis relieved. Neuralgia not benefited, and patient, May 5, 1891, at home, but still a sufferer from prostatic neuralgia.

Case 11.—Male, 63 years. Operation March 9, 1891. Tube removed fourteenth day. Wound about closed April 22, when patient was last seen. Recovery.

The operative technique is as follows:

The preparatory treatment consists in emptying the alimentary canal by laxatives and enema. The pubes and perineum should be shaved before the anæsthetic is given. After narcosis is complete, the patient should be placed on the back, the pelvis about six inches higher than the head, so that the contents of the abdomen may gravitate toward the diaphragm. A soft catheter is inserted, and the bladder filled with eight or ten ounces of warm Thiersch's solution, which is allowed to flow out through the catheter, and this is repeated until the fluid escapes fresh and clear. Finally, about ten ounces of this solution are injected, the catheter withdrawn, and the urethra closed by ligation of the penis with rubber tubing. In females the bladder is kept full by digital pressure of the urethra against the arch of the pubis, or by plugging.

In cutting into the bladder, the point to be made for is the upper surface of the symphysis pubis. The incision usually extends about two inches above and an inch below this point. In

very fat subjects it may be more extensive. It should be exactly in the median line, through the skin and muscles. It is usually an advantage to snip the muscles from the upper margin of the pubic bones for a half inch on either side. In case a large tumor or stone is encountered, this lateral incision may be enlarged to within one-half inch of the inner pillar of the external abdominal ring. The supporting power of the muscles is not permanently impaired by this section, which is best made with curved, dull-pointed scissors, and by cutting close to the bone all bleeding may be avoided. By retraction of the parts divided, a varying quantity of fat (the pre-vesical fat) is encountered lying on the anterior wall of the bladder and in contact above with the inferior fold of the peritoneum. With the finger nail (or, if necessary, the dull scissors) this fat is separated from the slight attachment to the inner surface of the ossa pubis, and also lifted upwards by the same means from the anterior bladder wall. In this manner the bladder is exposed for about two inches in its perpendicular axis, and the peritoneal fold is carried up with the fat, and is, as a rule, not seen. Only once or twice have I seen the peritoneum in my operations. The bladder is now in plain view, and the line of incision into the viscus is in sight. If any large veins are seen, and these are so located that their division is unavoidable, they should be tied with catgut passed beneath them, but not into the cavity of the bladder, by a small,

curved Hagedorn needle. In order to keep control of and to support the bladder after its contents escape, and to serve as a guide to the introduction of the finger or any instruments, on either side of the proposed line of incision, a silk thread is inserted into the wall of the bladder by means of the Hagedorn needle. The thread being inserted, the needle is unthreaded, and the ends tied about one foot from the wound, leaving a movable loop. Everything is now ready for cutting into the bladder. A long, blunt retractor should be inserted on either side to hold the soft parts back, while a third shorter one draws the pre vesical fat apart, and with it the peritoneum. The silk loop being sufficiently tightened, a short knife is carried, the back downwards, in contact with the inner surface of the ossa pubis, until the point strikes the bladder about one-half inch below the level of the symphysis, when it is pushed through the anterior wall, which is rapidly incised in the median line upwards for one or two inches. As the injected solution escapes, the finger is introduced and a thorough exploration effected. If for any reason the bladder is deeply sunk in the pelvis, the Barnes dilator may now be inserted per rectum, filled with 4-5 ounces of warm water, and by this means the floor of the bladder is lifted toward the wound. I have not had to resort to this expedient in more than three instances.

If a stone or foreign body is present, it may be removed with a light forceps or the finger. I

find the index finger answers better than any instrument. When a tumor is present, it is easily recognized by the touch. The most satisfactory instrument for removing tumors of the bladder is a small fenestrated Spencer Wells ovarian sac clamp, the teeth of which have been filed off. With the finger tip resting on the tumor, the instrument is carried down with one jaw on either side of the finger until it slips from the finger tip on to the neoplasm. It is then pushed snugly on to the mass, the jaws closed, and the instrument twisted around and around until the tumor is twisted off. Any particles which may remain are in like manner removed. The retractors are now carried into the bladder, and thus stretching the wound wide open, will permit thorough sponging of the cavity and an ocular inspection of the walls. The Pacquelin cautery point may now be introduced, and the base of the neoplasm seared over. While this is not essential in ordinary prostatic hypertrophy of the middle or lateral lobes, it is imperative in malignant neoplasms and in papillomatous growths. If hæmorrhage is severe, it may be controlled by compression with warm sponges, or by water at 110-115° F. The after-treatment of the bladder will depend upon the condition of this organ. In all cases where cystitis exists from stone, foreign body, tumor or other cause, drainage is indicated, and, of course, where the urethra is impermeable or the bladder paralyzed, it is imper-

ative. When no cystitis is present, it is advisable to close the wound in the bladder wall at once.

In only two of the twenty-three operations was an immediate suture undertaken, and in these cases the wound closed promptly without leakage. Both were in women.

A short, curved, small Hagedorn needle is armed with small, firm catgut (juniper oil gut is preferred). The edges of the incision in the wall of the bladder are brought up into the incision through the abdominal wall by traction on the silk thread already introduced, or by tenacula, and the sutures introduced in this manner. About $\frac{3}{8}$ of an inch from the edge of the incision the needle is carried into the wall of the bladder—not through it—and is made to emerge on the cut surface just where the mucous membrane rests on the muscular layer. It enters on the same level on the opposite side, and is carried out at the same distance from the edge of the incision. The space between the sutures is from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch. When all are inserted, they are tied and cut $\frac{1}{2}$ inch from the knot. The abdominal wound may now be stitched a short distance from its upper and lower angles, but as much as corresponds to the line of sutures in the bladder, is left open. A careful disinfection is now made, and the wound snugly packed with iodoformized gauze; bi-chloride dressing over all. Should leakage occur, the open wound prevents all danger. A soft catheter should at once be inserted into the bladder by the urethra, and tied

in. After three or four days, should irritation of the bladder or urethra supervene, it may be removed and reinserted at intervals to draw off the urine. In from seven to ten days the wound will be united sufficiently to permit the patient to empty the bladder at will. It is of great importance, however, that no urine should be allowed to accumulate within the first three or four days for fear of separating the edges of the wound.

In the majority of cases operated on, I have employed temporary drainage, and in two cases permanent supra-pubic drainage was established.

Temporary drainage is very satisfactorily secured by the Trendelenberg T tube, made of ordinary white rubber drainage tube, with a lumen of about $\frac{1}{4}$ of an inch. This tube is about ten inches long, one end being carried through a split in the center of a smaller piece of tubing about two inches in length, which is securely stitched to the larger piece. A single good-sized hole should be cut in the larger tube just at the level of the cross-piece. In inserting this tube, the cross-piece or top of the T should be folded back in the jaws of a pair of dressing forceps, and carried down to the bottom of the bladder, when, on loosening the forceps, the cross-piece springs out and prevents the dislodgement of the tube. A final flushing of the bladder with boro-salicylic solution is now made, and the wound about the tube snugly packed with iodoform gauze. In doing this, while the tube should not be closed

by pressure of the packing, it should be tight enough to keep air out of the bladder so the siphon-action of the tube may not be interrupted.

A smooth, well-adjusted piece of glass tubing about four inches long is now inserted into the rubber tube, and to this a long piece of rubber tubing is attached, the end of which leads into a vessel beneath the bed. To start the siphon-action the tube needs to be partially filled with water, after which the end is lowered, the water flows out, and the contents of the bladder follow. The outflow can be regulated by compression of the tube with a safety-pin, so that it falls into the vessel drop by drop just as fast as it is discharged into the bladder from the ureters. The patient for the first few days rests upon the back. The coil or loop of the drainage tube should be secured to the dressing and the edge of the bed by safety-pins, so that it may not drag upon the wound. Should the tube become displaced, it may be reinserted, using the two silk loops left in the wall of the bladder on either side of the wound as guides.

Properly managed, the drainage by this method is perfectly satisfactory. I have had patients thus treated in whom the dressings did not get wet or have to be changed oftener than once in four or five days. There is no need, in my opinion, of an additional operation through the perineum to secure drainage by gravitation. At least, I have not felt the need for this method in any of my cases. The length of time the tube

remains in the bladder will, as has been said, depend upon the condition of this organ. When the operation is done for removal of recent foreign body, or of a small tumor which has not caused cystitis and does not bleed much after removal, immediate suture of the bladder is indicated. When only moderate cystitis exists, should the urine clear off nicely in from three to seven days, the tube may be withdrawn. When this is done, a loose dressing of gauze and cotton is laid over the wound to absorb the urine which wells out. This will have to be changed at frequent intervals. In a few days the urine will partially flow out through the urethra, and by the end of from two to six weeks all will be discharged by the natural way.

Occasionally a small fistula may persist, which will require either to be packed with iodoformized gauze or scraped out with a Volkman's spoon to insure its closure. In paralysis of the bladder, and in certain cases of obstruction either in the urethra or by hypertrophy of the prostate in which the bladder has lost so much of its tone that it can only empty a portion of its contents, leaving the remainder to press upon the rectum and to produce cystitis and discomfort, permanent supra-pubic drainage is indicated. This is best accomplished by a velvet rubber catheter arranged so that the eye-end, passed through the wound, rests easily upon the floor of the bladder. On the skin at the outer end of the fistula rests a shield of soft rubber, about $\frac{3}{4}$ of an inch in

thickness and $1\frac{1}{2} \times 3$ inches surface measurement. It is held firmly in place by four pieces of tape attached to the four corners of the shield and tied two around the waist and two beneath the groins. The soft catheter is firmly moulded or soldered to the shield. In its outer end a small cork is inserted. As the urine collects sufficiently to demand evacuation, the bladder forces out a portion, and as soon as it ceases to exert power enough, the cork is removed from the catheter and the residue is then siphoned out. Patients wearing this tube enjoy great relief over their former condition, and can attend to work or social duties in comparative comfort.

In the present condition of my knowledge on this subject, I am deeply impressed with the safety and value of the *high operation*. For the thorough digital exploration of the bladder it is superior to *perineal cystotomy*.

The same is true beyond all question in the removal of tumors.

For drainage of the bladder, whether temporary or permanent, it answers every purpose.

For removal of stone or foreign body, to my mind it is so easy, safe and satisfactory that I prefer it to the low operation. In the light of my personal experience, I do not see why suprapubic cystotomy should not supersede all other methods of cutting into the bladder.



PERITONITIS, FROM A SURGICAL STANDPOINT.

BY M. PRICE, M.D.,
OF PHILADELPHIA, PA.

There is no more important subject presented for our careful consideration, or more deserving our most earnest thought, than peritonitis.

It is practically a new field for investigation; few of us comprehend its magnitude, or the importance of the work now being done. Idiopathic peritonitis is a myth and a delusion. The error has been that symptoms have been mistaken for the disease, and when relieved, a cure is accredited to some special form of treatment. Vomiting and tympanitis with pain does not necessarily indicate peritonitis.

There are many conditions of the digestive tract that will give all these symptoms, yet no peritonitis be present. And you may have peritonitis without pain, without tympanites, in fact, almost devoid of symptoms, yet have many ounces of purulent fluid in the peritoneum.

Peritonitis always has a cause, and if the case be properly investigated, we can find it. For so

serious a condition, it is one of the most curable diseases we are called to treat. That is, if we investigate the cause, and remove it. And then again, it is most wonderfully submissive to bad treatment. Improving again and again under the opium treatment, which is the worst of all, for it blinds the practitioner to the dangerous forms when they do appear for proper treatment, and where nothing but the proper treatment will save life. I marvel at the great credit men give to the opium treatment of peritonitis. And when recovery takes place, credit all to their treatment, with not one thought of the wonderful protective power of nature to guard her inner work.

Have they treated the condition, the actual disease, the exciting cause? No, in most cases they have not even investigated to find the cause; but have contented themselves with the thought that their patient is now all right, notwithstanding the fact that the patient suffers repeated attacks, until there comes a time when the operating or the post-mortem table reveals to the wondering practitioner a cause. Thanks to the surgeon, we do not have to resort to the post-mortem to find what has given our patient peritonitis, or the way for their relief. I purposely avoid quotations from standard works; all of you are familiar with them, and as most they say does not interest us at the present day, I will not trouble you with either their pathology or their so-called treatment, with opium as their sheet anchor. I except those writers of a century ago: Dewees,

and that great teacher and writer, George B. Wood. How strange that medical men are so forgetful of the teachings of these masters of their day ! Men follow the fashions of their professors.

Peritonitis is a disease so peculiarly surgical in the development of its pathology, and the perfection of its treatment, and the utter extermination of its mythical origin, that we do not any longer have to resort to the dead-house for our knowledge of its history. Ante-mortem examinations have taken the place of the dead-house pathology of only a few years ago. We all remember to have made such examinations that, to-day, by operative measures, the patient could have been saved. Its cause removed, and thereby forever preventing the return from the same point of infection. For some of these cases passing through my hands have had as many as five different attacks, and had it not been for surgical aid they could not have been saved.

The peritoneum in health is a lymph sac enclosing every organ in the abdominal cavity. There are a few exceptions to this rule, but of slight moment in the consideration of the subject of the inflamed condition. A peritonitis may be partial, or it may include the entire membrane ; a general peritonitis. The symptoms are mild or severe, partial or general, owing to the nature of the irritating cause. It will, in most cases, begin with a chill, but not always. It usually has at the beginning a high temperature,

but not invariably. Pain on pressure is one of the best, and by all odds the most valuable symptom we have to guide us to a correct diagnosis. Yet, the pain may be so slight that the patient may not call our attention to its existence. The pulse may be quick from the start, and, after a short period, become hard and tense.

There is no single symptom that can be depended upon, many patients when operated upon having a pulse as high as one hundred and fifty, and they made just as rapid recovery as those whose pulses were at eighty, full and strong. In most cases, however, the pulse is thin and thready. Tympanitis is not a constant symptom, though one that gives a great deal of trouble, and adds wonderfully to the risk of the patient.

The expression of the face, next to pain, is probably one of our best diagnostic symptoms; it is one of great anxiety and alarm expressed in every feature; they seem to have aged many years in a single day. The features seem pinched and prematurely old. The bowels are always constipated, unless we have a case of peritonitis resulting from dysenteric ulceration, or from some complication of the intestinal tract. The old treatment of putting the bowels in splints by opium was certainly unnecessary, as it had already been done most effectually by the paralyzing influence of the inflammatory condition.

Then, to properly understand the condition of our patient, we must investigate every organ in

the abdominal cavity; the pelvis through the bowel, if it be a man, and through the vagina, if a woman. We can thus derive great help and often a perfectly clear understanding of the condition, when we can get it in no other way.

In almost all the cases to which we are called to remove the source of infection, the effort of nature to limit its destructive ravages are well marked by protective lymph walling in the diseased portion. In the many examinations we have made on the operating table of peritonitis, the conclusions that have been forced upon us by such investigations prove to my mind that there is always an irritating and demonstrable cause for all cases of peritonitis.

I have never found a case without positive indications of destructive changes going on in the infected parts, the contents bathed in serous sero-purulent fluid, with adhesions varying from slight to those so firm that it was easier to tear the surrounding tissue than the adhesions, with small collections of pus in many different places walled in by the peritoneum in its efforts to prevent general infection. Young and old alike suffer from its ravages. Both sexes do not suffer alike, for the reason that women are by all odds subjected to many times the dangers of this condition by causes peculiar to their sex.

The older writers did not give peritonitis a separate place, but associated it with other lesions within the abdominal cavity, clearly showing they did not endorse the theory of its

idiopathic origin. How near do they come to the pathology of the present day?

I have, in the last five years, operated or assisted with five hundred operations for the cure of peritonitis; all of them so serious that life without operative treatment could not have been saved. All of them had been treated by medical men of the best standing in the profession, and at least four-fifths by firm believers in the opium treatment. Many of these patients had suffered more than one attack, some of them as many as five before they had come to that point of their disease where some radical measures had to be resorted to to save life and remove the point of infection. Beside this, I have examined some twenty, who were past all surgical aid when I was called to their side, and in every case a well-defined cause was found for all the trouble. There was not a single case examined in all this long series of cases without lesions of such serious nature that they must by their very character have proved fatal at no very distant day. There was not one case of idiopathic peritonitis in the list, though more than one-third of them had been so named by good men. In the month of December I had the good fortune to assist at eleven bad cases of localized and general peritonitis, and operate four times myself, all of which must have been fatal very soon, some of them having had several attacks.

The advocates of the opium treatment speak of the disappearance of the distention, and soft-

ening of the abdomen after a number of days. In our experience if the case be one of true peritonitis, and the symptoms do not improve under saline purgation, and the temperature come down below the pus standard in from three to five days, we at once decide to remove the cause by operative measures, and I have yet to regret the use of the knife in these cases, but I can say I have to regret some of the delays I have been persuaded into by the fears of other counsel in the cases. Prompt purgative treatment in the beginning of peritonitis, by the saline purgation or the mild chloride of mercury, to clear up the case in the very beginning, and then when you have done all this, and there is no improvement you must, in the present light that surgery has thrown on the subject, operate.

Peritonitis from other causes, the indications being the same, show the great tolerance to manipulation and contact with the poisonous pus in which every known form of microbe must have existed by millions, where large flakes of inflammatory lymph had to be removed by scissors, where the adherent bowel was detached from the pus sac, and yet with all these complications and with all the microbes and pus there was not one case of peritonitis following operation in the whole series of over five hundred cases. What were the causes for all these five hundred cases of peritonitis? all had a cause, and the cause was found in every case. To enumerate all the causes that might cause peritonitis

would be a most thankless undertaking, for they are innumerable. The vast area and the important glandular organs enclosed in the peritoneum, add their mite to the list, but by all odds the most prolific cause of peritonitis comes from a diseased condition of the uterine appendages; these offer a direct way of entrance to some of the most virulent poisons to which women are exposed. This mode of entrance and the subject to which it relates, and its influence in the formation and production of peritonitis, local and general, has been the subject of many papers, I might say volumes. I need not here mention it more than as a prominent cause.

Second in importance is that of appendicitis. Here is a prolongation of the large intestine, unused, a place for the lodgment of foreign substances and concretions of its own formation, with none of the cleansing and purifying conditions which other portions of the bowels are constantly subjected to in the constant moving of the contents, and the contact of the secretions of the digestive fluids of the different glands, which have by Nature been placed to correct just that condition to which the appendix is exposed, with no power to remove. From this source come many of the causes of peritonitis.

In the treatment of peritonitis in the past great latitude was allowed, and medical men made the most liberal use of the privilege in the use of opium and its preparations. Some delighting in the extracts, others a mixture with other

drugs, all trusting with implicit faith in morphia in large and repeated doses as much as one grain every two hours, others recommending as much as four hundred grains in the twenty-four hours of the pure extract of opium. Others prefer the liquid preparations, they in their turn mix and blend them in a manner and with a faith as to their marvellous curative qualities that some of us are unable to understand. Great weight is laid on the indications for the use of opium; one observer is satisfied when the patient is relieved of his pain, another not content with this condition alone gives opium for its effect, and his measure of guidance is the respirations; when they have been reduced to ten or twelve per minute, he then considers his patient safe. Then when opium does not bring the result so earnestly sought after, they use a combination of calomel and opium; one they say to stop the secretion of bile, and the other to start the bile on its usual way. They report many happy results, many patients saved by this most ingenious blending of the incompatible. The other treatment contemporary with that just alluded to of peritonitis, such as poultices, blisters, turpentine and the warm application, all to my mind indicate what the practitioner expected to be the result—the formation of pus. This is just the treatment he would give to an existing or threatened abscess in any other portion of the body. How long will this state of things last! Can we not offer them some more encouraging method of treat-

ment? I think we can. I hope the day is past when we will follow blindly the teachings of any man or set of men, but will weigh the facts as they are given us, and from them and our own knowledge of the subject, build a new and more comprehensive treatment than that of the past, which I fear is now almost the only treatment for this most destructive disease when not properly treated and by the most energetic and rational methods.

My firm belief is that when called to a case of supposed trouble to make at once earnest search for the cause, and, if found, to remove it at once, is the proper course to pursue. If the cause be not apparent, then clear up the case with saline purgatives, and when not able to do so, then abdominal section. And, as I have said before in this paper, you will never have cause to regret it. Prompt adherence to this rule has been the practice of all those men who have learned their pathology at the operating table instead of the dead-house.

The present way of treating these cases was also the old way used by the majority of the profession. The very first thing is opium in some form to relieve the pain, as they will tell you in most cases without looking for a hernia, or any other cause for the trouble. Pain is the only symptom complained of, so most men are content when the patient is relieved of that.

I have been called to a patient suffering from strangulated hernia, with all the symptoms of

peritonitis, and the medical attendant not aware he had anything more than a case of idiopathic peritonitis to deal with. I will venture to say, that if all the medical men in this city could be asked what the first thing they would do for a case of threatened peritonitis, they would say relieve him or her of pain by opium. It is the almost universal rule, notwithstanding the stress laid on the great danger to the patient in such treatment.

There is still another and most important reason for early treatment in these cases. We all know that one of the favorite and accepted theories of the introduction of tubercle bacillus is through the stomach in its deranged and diseased condition from any cause, and in this way into the general circulation to be deposited in that portion least able to resist its ravages. In these cases where we have a subacute inflammatory condition with large deposits of inflammatory matter of low vitality, where the circulation is in a most unsatisfactory condition, where the thermometer indicates a temperature in which these little bodies grow and flourish to a most alarming extent, tissues of low vitality are fastened together. What better culture ground or condition could even a pathologist wish for in which to feed and grow his medical menagerie. Be this true or not, the fact still stands forth that many of these chronic cases die of tuberculosis.



PLATINUM NEEDLES FOR ELECTROLYSIS.

BY ROBERT NEWMAN, M.D.,
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CONSULTING SURGEON TO HACKENSACK AND BAYONNE HOSPITALS, ETC.

It is at present difficult to procure a small sized platinum needle, which is in every respect satisfactory to the operator.

The needles on the market are deficient: for instance, the insulation is rough, uneven, and not smooth on an equal plane from the non-insulated point, to and over the beginning of the insulation, the point is too dull, and will not readily pass through cuticle and fascia; the non-insulated part is weak, and breaks off easily; the shaft, or the whole needle is not stiff enough to be easily pushed into the tissues, and on any attempt at use will bend. The shape of the point is also objectionable, and makes a hole at the point of entrance, instead of cutting evenly and pushing through the tissues more by dilatation, than in such a manner, so that on withdrawal of the

needle the point of entrance contracts again, without leaving a bleeding surface.

USE OF NEEDLES.—With the progress and better understanding of electricity in Surgery the use of needles in electrolysis will increase. So far they have been used in the following diseases: Aneurism, varicocele, hydrocele, nævi, portwine marks, angioma, erectile tumors, epilation, xanthoma, ranula, hernia, bronchocele, different tumors, carcinoma, diseases of the prostate, ovarian tumors, fibroids, peri-uterine hæmatocele, salpingitis, hydrosalpinx, and others.

The enumeration of these diseases, in which electrolysis with needles has been used, is made here only as statistical facts, with no intention to elicit a discussion as to whether or not in special cases electrolysis is the best means of treatment. It is a fact, that electrolysis with needles has been used often in a variety of diseases. The probability is, that in the near future, this procedure will be practiced oftener; and therefore the point at issue is, that it is important to procure good needles, if an operation by electrolysis is intended.

The action of electrolysis is principally a chemical decomposition. If, for instance, chloride of ammonium be decomposed by electrolysis, the chlorine liberated at the positive pole will react upon some of the remaining salt, giving free nitrogen and chloride of nitrogen. If iodide of potassium in solution be subjected to electrolysis, one equivalent of iodine liberated at the positive

pole will also have one equivalent of hydrate of potassium liberated at the negative pole, showing that the potassium liberated from combination with the iodide has combined with some of the surrounding water. Potassium and sodium are liberated in a nascent state, combining with the oxygen, thus forming compounds, as caustic soda and potash.

If needles are used for electrolysis this chemical action takes place in the tissues, as well as in the needles; the needles themselves will suffer this chemical decomposition in such degrees as the metal used has the capacity of an electrolyte. If, for instance, zinc needles are used, chloride of zinc will form and remain in the tissues and act as a caustic. All metal needles will oxidize at the positive pole. The knowledge of the decomposition of metals by electrolysis has been used practically by trades and arts and in electro-metallurgy. The electrolytic action is mostly polar, that is the elements liberated will collect at their respective pole, and may extend within a certain radius around the pole. It seems, there is no inter-polar electrolysis; that means while the molecular action travels between the poles, no alteration of tissues or cells has been found in the intervals between the poles, and the changes were confined to the poles and their surroundings. In experiments made I found the action of electrolysis extended to $1\frac{1}{2}$ inches around the poles.

These brief remarks of the electrolytic action on needles will suffice to show how important is

the selection of the metal for needles. In some operations the negative needle may be of steel, for others the operator may prefer any other metal to carry out his particular intentions. There are many cases, in which it is essential to use a needle of metal, which neither oxydizes or decomposes by the electrolytic action. There is only one metal which has all the qualities necessary in such cases, that is platinum. It is not in the scope of this paper to discuss what kinds of metal should be used in the different operations; the only object is to show how platinum needles should be made, in order to answer their purpose.

Platinum is a metal of the color of silver, but less bright. Its specific gravity is 20. It is harder than iron, undergoes no alteration in air, resists the action of acids, and can be rolled into thin plates and wire. It is also ductile, which is the only drawback to its use under consideration. The needles are very flexible and bend easily; for the same reason it is difficult to make a sharp point which will readily penetrate the tissues. If needles of a large size can be used, we have no difficulty, and platinum answers well, but the trouble begins when a needle of a small size is required to be introduced into small nodules, through tough tissues.

Here are some samples of the deficiencies. The needle is often too flexible, and the point dull and fragile, so that on an attempt to penetrate the tissues it either bends or breaks, or the insu-

lation is insufficient and rough. Instrument makers make either or all these errors.

A perfect insulation is made in New York at one place only, viz.: that of Geo. Tiemann & Co, but their beautiful insulation as a rule weakens the needle, though lately that error has been to a considerable degree corrected.

A good needle for our purpose must possess the following qualities:

1. It must be of a small size, in order to enter dangerous anatomical places, without injuring vessels, etc.

2. There must be stiffness, which enables the operator to push through cuticle and fascia into tumors without bending.

3. The point must be sharp, entering the tissues without causing hæmorrhage, a wound or slough.

4. The whole needle with a perfect insulation must be even and smooth.

It will be perceived that the construction of the ideal platinum needle of small size offers many difficulties, which are not easily overcome. Only those who have experienced failures, understand what resistance the tissues offer to the entrance of the needle, and what force is needed to push the needle to the desired position. First are the cutaneous surfaces, which offer resistance and often the point breaks, the shaft bends and the passage of the needle appears almost impossible. After an entrance is effected the needle generally passes smoothly through the soft tissues, but only to

encounter a new obstacle by coming in contact with the fascia. Some deep fascia are very tough and offer considerable resistance to the force of the operator, even with stiff steel needles. Among those points may be mentioned—the cervical fascia, the thoracic fascia, particularly the ligamenta suspensoria, enveloping the mammary gland, the deep fascia under the pectoralis muscle, the fascia lata of the thigh, which is the thickest in the upper and outer side of the limb; the gluteal aponeurosis, investing the gluteus medius. At the linea aspera we find two strong inter-muscular septa. After the needle has overcome these obstacles it meets other dangerous anatomical points of vessels and nerves, through which it must be guided to its proper position before the electricity is allowed to work. The position of the working point of the needle must be in a place far enough from the cutaneous surface and the point of entrance, in order to avoid burning these parts, which would be followed by sloughing ulcers, leaving behind very ugly scars, as mementos. There are also tumors, some having on the outside a capsule, which resist an entrance of almost any force. Considering all these difficulties I have given my orders for a small platinum needle as follows:

The needle to be 3 inches long; size equal to a No. 6 French scale. The working point (non-insulated) three-eighths of an inch long. The point, spear shaped with as fine a point as possible, the widest part of the spear one sixteenth F. inch.

The needle must be stiff enough to pass through tissues without bending. The blunt end of the needle non-insulated to be connected with cord by a binding screw. The whole needle well insulated, except at its extremities, as mentioned, smooth and even.

In order to make the platinum stiffer than in its natural state, iridium was incorporated into the platinum wire; of which only $2\frac{1}{2}$ per cent. can be taken up. Iridium is found as an alloy, sometimes with platinum; it is very hard and unmalleable. Its chemical equivalent is 99.

There were many failures by different instrument makers; but by persistence, and at last with the aid of Messrs. Geo. Tiemann & Co., of New York, I am able to exhibit now, a needle which is almost perfect. It is best to use platinum only for the working part of the needle, and to manufacture the shaft of steel. This gives more stiffness to the needle and therefore more direct force can be used to enter the tissues without bending or breaking. In the manufacture of the needle it is necessary to connect the two parts firmly together, and at last to make the insulation smooth, running even from point to shaft.

This needle has answered all practical purposes so far, but there is a possibility that a case may present itself having tissues which resist all efforts and force of the needle. In such a case I use first as a leader a strong steel director which is grooved, having a sharp broad point, both sides below the point are sharp and easily cut its

way through the cuticle and fascia. This director will pass anywhere and is pushed in the place where the platinum needle is desired to follow. Then the platinum needle follows the director in its groove and is pushed above to its place; the director is withdrawn and the electrolysis is made without any difficulty. The director passes direct and straight, making a smaller hole in the cuticle than an uncertain, bending needle would, and after withdrawal of the needle no opening could be seen after the operation.

With the improved platinum needle and, if necessary, the aid of the steel director, the electrolytic operations can be made with certainty, safety, and success.

SOME POINTS IN THE SURGICAL TREATMENT FOR THE RADICAL CURE OF HERNIA.

BY AUGUSTUS P. CLARKE, A.M., M.D.,
OF CAMBRIDGE, MASS.

One of the most important features in the surgical treatment for the radical cure of hernia is the selection of the proper material for sutures. The sutures in all cases should be aseptic. The wound made by the incision should also be kept aseptic. The operator should have knowledge of the manner in which the sutures have been made, and in order to have such knowledge he should superintend their final preparation. Sutures which have been prepared and are sold in shops should in no event be trusted, notwithstanding the careful manner in which they may seem to have been prepared. No one, except the surgeon, or his immediate assistants who are to use them, and who have taken occasion to make most careful observation, is at all likely to appreciate this necessity, and to carry out in every detail measures necessary for assuring their

preparation in such a manner that they can be relied upon as being surgically clean and perfectly free from germs. Experience has demonstrated that the best material for buried sutures is that obtained solely from animal substance. Catgut and tendon when properly prepared afford the best material as is yet known for such sutures. Considerable experience is required in chromicising them. If the sutures remain long in the acid they become hard and offer too much resistance to the action of the tissues. The same effect occurs when the quantity of acid is in excess of the due proportion. If, on the contrary, the sutures are not sufficiently chromicised they undergo absorption before complete union of the coapted parts of the wound takes place. Silk ligatures, however carefully prepared, should not, as a rule, be employed in operations on hernia; their substance is not akin to those of the tissues into which they are to be inserted; they are liable to be the medium either directly or remotely of sepsis, and are rarely, if ever, absorbed. In cases in which they have been used, it has been necessary, for the most part, to establish some means of drainage. Such expedients serve to prevent the occurrence of immediate adhesion of the tissues, and to render the line of union weak and yielding, and consequently to afford but little protection against a return of the hernia. The same may be said when horse hair and certain other materials are used for such sutures. It is true that for affording immunity against the re-

currence of the hernia, the internal ring may be embossed by the inverting of the sac on its peritoneal surface. This measure may, for the time being, be of some service, especially in a case in which a well fitted truss is worn. Such unnatural coaptation of parts is liable, however, to yield before the super-incumbent pressure of the abdominal viscera and thus to cause a return at length of the hernia. Application of quilled sutures falls far short of accomplishing what is most to be desired, for the adoption of this method of procedure, when silk, or like substances are employed, has to be supplemented by some special provision for drainage to the wound. One of the features which I here insist upon to be achieved is that the several different tissues be coapted, each in its proper order and that direct and immediate union be secured without the necessity of having to resort to any method of drainage whatever. Another important feature to be secured in the operation is the restoration of the obliquity or the valve-like form of the inguinal canal, and also of the internal and external abdominal rings. Attention has been called to the importance of this measure, but as yet, I believe, it has not been generally appreciated. This may be effected by free dissection proceeding from the internal ring. In cases in which the tissues have undergone serious changes, or the parts have become distended, deformed, thickened or attenuated, much difficulty will be encountered in accomplishing such restoration. Every effort, how-

ever, should be made to bring back the canal as near as possible to the typical one, as regards length, diameter and obliquity. In those cases in which the canal has become tortuous, or in which the opening is formed at an undue angle to the parietes of the abdomen, and the parts are not reformed, but are left in abnormal condition, the operation undertaken for the radical cure will prove to be of temporary benefit only. Statistics are sometimes offered by different operators to show that certain methods of practice are attended with unusual success. Statistics can be of but little value when the individual operators select cases with the view of showing favorable results of their special methods of operating. In a case in which the sac is to be removed the cord should be freed as high as possible even if the peritoneum has to be impinged upon. The sac should be sewed off by means of aseptic animal sutures; and if the other steps in the operation have been properly taken there will be scarcely any danger of a return of the hernia. There are several advantages in the method of removing the sac. Prominent among them is the greater facility for inspecting its contents and for guarding against the possibility of reducing parts which may be in a state of inflammation. Such a condition of the parts is particularly apt to occur in cases of strangulated hernia, after prolonged taxis or other measures for relief have been undertaken. When the hernia has been properly reduced, the sac should be regarded only as an

unnecessary incumbrance. The sac is formed originally from the parietal peritoneum, which frequently becomes distended and thickened. The various changes in its nutrition and vascularity often lead to irritation, inflammation and adhesion, according to circumstances and accidental conditions. In all cases, after opening the sac the surgeon should see whether the circulation returns. If the parts have been too long compressed and there is much danger of sloughing it will be advisable to resort to resection of the necrosed portions and not to assume risks of returning them. After opening the sac and relieving the constriction, and before making reduction, the contents of the sac should be carefully examined. If there is evidence of inflammation or an effusion of lymph, free irrigation with mercuric bichloride should be had recourse to. The sac should then be sewed across at its neck with animal suture, and be excised. Different methods of operating for the radical cure of hernia from time to time have been reported. Emphasis is often laid upon the adoption of the most careful antiseptic precautions. A more particular examination of such reports almost invariably reveals the fact that some method of drainage has been employed. Among the methods observed is the one in which the horse-hair drain left in the canal, or "gauze plugs" connected with the wound; and that the wound united by "granulations from the bottom." The failure on the part of the operator to keep the wound asep-

tic must necessarily render the line of union weak, the parts in large measure devoid of vitality, and thus incapable of overcoming the pressure which is the cause of the recurrence of the hernia. This is the reason no doubt why so many different methods for the radical cure of hernia have been devised and why each method of operating, for the most part undertaken by a different surgeon, so often proves unsatisfactory. In some cases of femoral hernia excision of the sac is almost imperatively demanded. In those cases in which Macewen's method is adopted the thickened mass is liable to set up more or less irritation, and to become the source of much inconvenience.

When the sac is removed the ring and canal can be narrowed, and sutures can be introduced in close proximity to the vessels without causing injury or disturbance to the circulation. Another advantage, according to Mr. Poland,¹ is that it allows the closure of the neck of the sac, and thus effectually prevents all hæmorrhage from the wound into the peritoneal cavity. After the sac has been removed the loose folds in the vicinity can be more nearly approximated; the exudation of plastic lymph readily closes the wound effectually from any communication with the abdominal cavity. After the edges of the pillars have been refreshed they may be brought together, and retained by aseptic sutures. By this means the canal is reformed but narrowed, and becomes

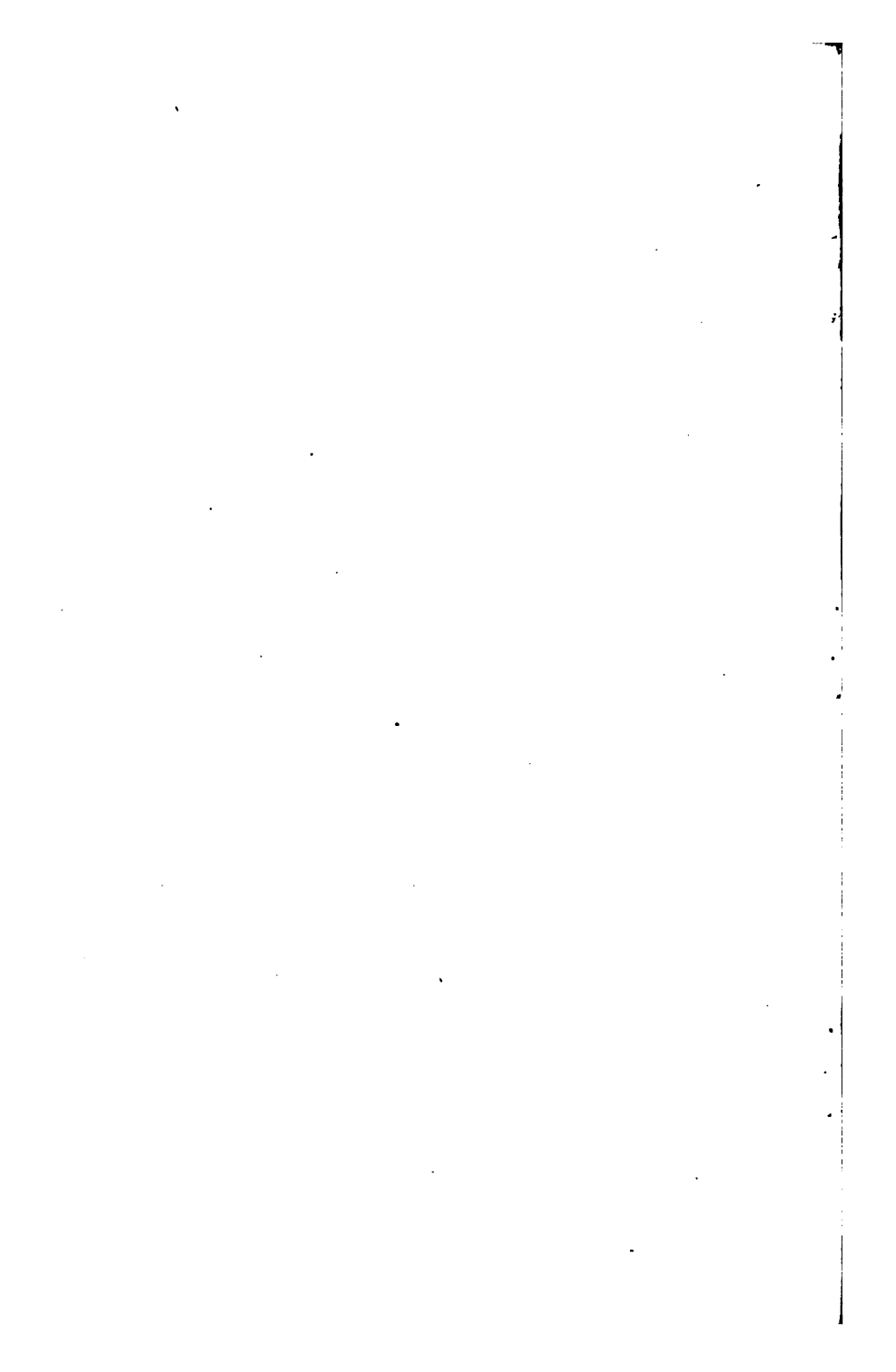
¹ John Poland, F. R. C. S., Braithwaites Ret., Part 98, page 124.

an effectual barrier against the recurrence of hernia. This method is evidently of far more importance than the one which seeks to utilize the sac by invaginating it in the canal and by converting it into a pad or fixing it as a boss over the internal ring. Of course, in cases of chronic hernia, in which there has been much inflammation, considerable difficulty will be experienced in separating the sac from the surrounding parts. If, however, much care be exercised, and a liberal use of the aseptic sutures be resorted to, the sac can be separated and be removed, to a certain extent, without incurring the risks of gangrene, suppuration or inflammation, and the operation will therefore not appear so difficult or dangerous as some writers would lead us to believe. In a recent case in which the hernia is quite small, the sac and hernia may have passed into the abdomen and so have disappeared. These cases may be operated upon without our interfering with the sac. The edges of the pillars should in such cases be refreshed, and approximated by aseptic animal sutures. The other parts are sewed together according to the method already referred to. In congenital cases the cord and sac are frequently found so blended with each other that to separate the one from the other is often most difficult and tedious. In such cases, when there is no appearance of recent lymph, portions of the sac may be left. The remaining fibres, for the most part, usually undergo absorption or degeneration. This measure in the operation is

quite different from the one which, as said before, seeks to plug the canal and internal ring by means of the retained or inverted sac that is liable to form a painful or hardened mass in connection with the ring and canal. In operations for the cure of hernia the use of wire sutures is unnecessary, and should not be encouraged. The use of wire sooner or later becomes the source of inconvenience, if not of serious trouble, and notwithstanding the efforts made in other respects to keep the wound aseptic, their presence is followed by irritation or ulceration, conditions that will necessitate their early removal, and thus compromise the usefulness and advantages that should be derived from the surgical measures undertaken. Other methods of treating the sac have been proposed. The cases in which the method by torsion of the sac can with any degree of safety be resorted to are too few for general considerations. In every such case the operator of course must be a law unto himself. In conclusion I would say that every operation, for the radical cure of hernia, in which the wound is kept strictly aseptic, including the employment of thoroughly aseptic animal sutures, the results will be most satisfactory, and but little danger is to be apprehended of a return of the hernia. These favorable results may be expected to follow in the cases in which the sac has, as far as possible, been excised, without injury to the cord or other parts. In all cases expected to be successful the operation should be so conducted

that no drainage, however simple in its details, should in any way be required. The necessity of observing this principle in operations for the cure of hernia has been urged by my friend, Dr. H. O. Marcy.² He says the "Coapted surfaces held aseptically at rest, readily tolerate the limited effusion which is utilized in the process of repair. The elimination of the drainage-tube renders the complete closure of an aseptic wound possible, and prevents its further extraneous contamination. Repair ensues as in a subcutaneous wound. The advantages of this method in the treatment of the wound is the assurance of non-infection. By every method of antiseptic dressing with drainage all surgeons have admitted the great difficulty, and, in children, the well nigh impossibility of retaining the wound aseptic." The results of the operations in the hernia cases occurring in Dr. Marcy's practice with which I have been connected, and also in those in my own for the past twenty years, fully justify the conclusion here reached. By the observance of these principles of aseptics in operative treatment for the radical cure of hernia, Dr. Marcy has, according to my judgment, attained a success that has scarcely been paralleled.

² Treatise on the Radical Cure of Hernia, page 87.



DISLOCATIONS, UPWARDS AND BACK-
WARDS, OF THE SCAPULAR END
OF THE CLAVICLE.

BY WM. H. DOUGHTY, M.D.,
OF AUGUSTA, GA.

In the July No. of the *Richmond and Louisville Medical Journal* (now *Gaillard's Medical Journal*), for 1876, I published an article entitled :

"True Method of Treating Dislocations, upwards and backwards, of the Scapular end of the Clavicle, with report of a case illustrating the principle employed."

According to standard authorities such injuries are rare and their treatment extremely unsatisfactory. Since 1876 I have seen but two cases, both of which occurred within a few months of each other in 1888: one in my own practice, report of which accompanies this paper; the other in that of my friend and neighbor, Prof. Thos. R. Wright, of this city, through whose courtesy I am permitted to refer to it, and report

an excellent result from the method of treatment given herein.

My first case was published in illustration of a new principle in the management of such injuries, and it was thought that the simplicity of the treatment and its satisfactory result would at least claim the attention of surgeons, if not their approval of the principle then first enunciated. I am, however, not aware of its employment, or even recognition by others, a fact that induces me to present it before this body on this occasion, with two additional cases, perfect in their results, to support its claims to confidence and adoption. Hamilton, in sixth American edition of his great work on "Fractures and Dislocations," Wyeth, Ashhurst (*Encyclopædia of Surgery*), still detail the old imperfect methods.

The wood-cut given with the first case was intended to show the position of the arm, mode of dressing for maintaining this, and the permanent reduction and retention of the displaced end of the bone. It was a poor "cut," a libel on an excellent photograph from which it was made, taken soon after the dressings were applied. The photograph accompanying the present report shows the *result*, having been taken six weeks after the injury: the loose worn bandage bespeaks its own superfluity, having been used longer than was actually necessary to prevent the premature use of the arm by a thoughtless youth. As to the permanency of this result, I may report that an examination of the parts in

March, 1891, nearly three years after treatment, revealed an altogether satisfactory condition. I



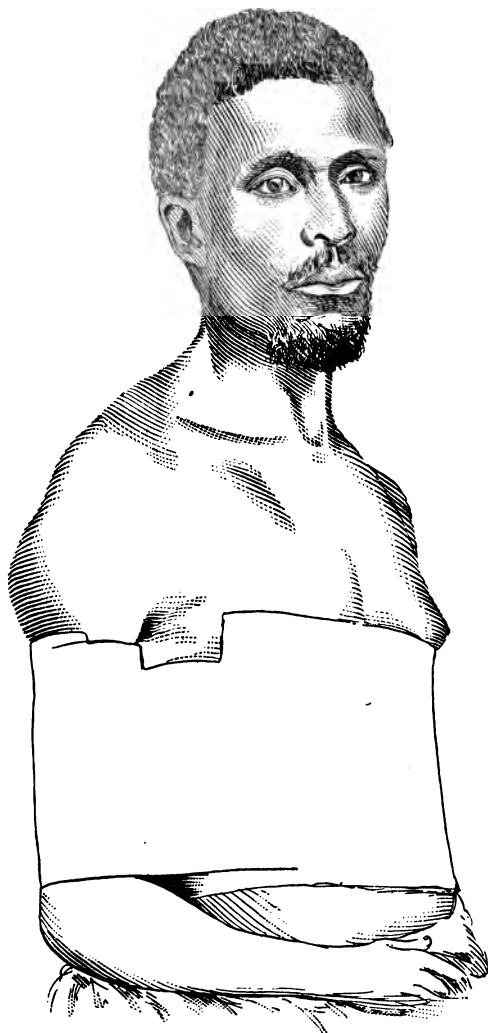
Injured June 1st, 1888. Photographed July 13th, 1888 (6 weeks), when bandage was removed. Illustrates result.

wish also to state that a similar examination of my first case after the lapse of twelve years

showed a reproduction of the displacement, although at the time of discharge of the case it was fully restored as then reported. This fact suggests the necessity of restraining the early, free use of the limb with laboring men as an additional protection against the return of the luxation. The acromio-clavicular articulation is perhaps one of the weakest in the body, surgically speaking, and may need therefore greater attention in this particular, especially with adults, subjects of injury.

Of the three cases now reported under this method of treatment two give unquestioned satisfactory and permanent results, while under former methods the latter were so rare that Hamilton says: "my notes furnish only *two cases* of perfect retention after a complete dislocation at this point" (p. 566), having recorded forty-one cases in all.

For the benefit of those who may not have read the former article on this subject (copy of which is enclosed herewith), the principle referred to, briefly stated, is as follows: *In lieu of direct pressure on the displaced end of the clavicle, made by pads, straps, bandages and other similar devices for retaining the same in position, it is suggested to draw the arm forcibly downwards and backwards against the side of the chest, thus stretching to the utmost the fibres of the deltoid arising from the outer third of the clavicle, and antagonizing the trapezius whose vigorous action maintains the displacement; and further, rotating*



Illustrates position of arm, mode of dressing for maintaining permanent reduction, etc.

and fixing the scapula by drawing upon its attachments (muscular and otherwise), to the humerus. The arm is then secured firmly and immovably by wide strips of adhesive plaster encircling the body and arm.

It is not necessary to encircle the arm first (see photograph of first case) and then the body and arm together, as there is liability when this is done to great tumefaction of the forearm and hand, as my second case developed.

A little reflection will satisfy the thoughtful that there is gained by this mode of management, as nearly as possible, the immobility of the scapula, the requisite antagonism of the trapezius by the deltoid, with the consequent replacement and retention of the displaced bone.

All of the structures about the shoulder-joint, thus drawn upon, aided by the substantial leverage of the humerus when pressed upon the side of the body, sustain the deltoid and contribute to the result. Moreover, the rotation of the scapula rather relaxes the fibres of the trapezius inserted into the spine of the scapula, while those of the deltoid arising therefrom are pulled upon. The position of the end of the clavicle, no longer free to move, is the mathematical resultant of the operation of these opposing forces, now equally balanced.

Thus, quoting from my former article, "by this simple mechanism was beautifully illustrated that cardinal principle in the surgery of dislocations, namely, that their safe and proper re-

duction and treatment can best be secured by a careful study of the muscular action that maintains the displacement (a factor in its production also), and the relations of the muscles that normally antagonize it." (P. 4).

By this plan of permanent adjustment the shoulder is left open to inspection at all times, and the bungling, irksome apparatus of every kind, heretofore employed, is dispensed with.

Report of Case.—On June 1, 1888, Herbert C., about 14 years old, was thrown from a road-cart, violently striking the right shoulder; was immediately disabled thereby, and complained of great pain in the shoulder and inability to move the arm.

An examination showed, besides a contusion of the soft parts about the shoulder, a dislocation upwards and backwards of the scapular end of the clavicle. The extent of the luxation was sufficient to produce a bulging of the fibres of the trapezius, very distinct, when viewed from all directions. Dislocation was easily reduced and bone maintained in position by method detailed elsewhere. Result was entirely satisfactory as will be shown by accompanying photograph taken on July 13, six weeks afterward.

ARISTOL: SOME OF ITS USES IN SURGERY.

BY WILLIAM C. WILE, A.M., M.D.,
OF DANBURY, CONN.

My attention was first called to the value of aristol in the treatment of surgical cases, by Dr. Eichhoff, of Elberfeld, Germany, and Lowenstein, of Vienna, whose reports were published in the early part of 1890. I have always been a firm advocate of the value of iodoform in surgery, but I had become well convinced of the fact that it was, in many cases, a source of great annoyance, from its repulsive odor, to a great majority of cases, and having seen many, where its poisonous effects were apparent, I at once became impressed with the value which must pertain to a remedy which was free from toxic effects, was inodorous and as valuable an antiseptic as iodoform. One of the very first cases in which I used it was of such a character, and the results were so satisfactory, that it almost immediately displaced iodoform in my practice, and from that day to this I have used aristol entirely when it was at hand and available.

Dr. Hobart Armory Hare, says: Experimental and practical clinical experience have shown that it can be used in all instances where iodoform can be applied externally, and it is said to possess the advantage of being almost entirely harmless to man, although it is a powerful parasiticide.

Dr. C. W. Allen, New York, in a paper read before the American Dermatological Association, gave the results of his experience with aristol, and summed up with the statement that it seemed to possess valuable cicatrizing, granulating and stimulating qualities, was void of the objectionable odor of iodoform.

Dr. Alois Pollak has employed aristol as an antiseptic in twenty-two cases of unhealthy wounds, abscesses, minor surgical operations (such as removal of small tumors or enlarged glands), phlegmonous inflammations and varicose ulcers, and is enthusiastic in praise. He used the drug in the form of a powder, or mixed with ether or vaseline. In all of the cases in which it was employed there was no reaction; and fever, if present, disappeared within twenty-four hours. No pain was experienced in or around the wound, and healthy granulations were rapidly formed. The author regards aristol as an excellent substitute for iodoform; its advantages being that it has no disagreeable odor, is effective in much smaller quantities, and a thin layer of the powder is sufficient to cover the wound.

Dr. Boufill calls attention to the great value of the drug in burns ; a 10 per cent. salve of aristol proving eminently efficacious.

Dr. F. Goldmann mentions the use of aristol in speaking of the frequency of burns received during laboratory work ; these are sometimes of a peculiarly severe type, but a 5 or 10 per cent. salve with lanoline effected a painless and comparatively quick cure, almost invariably.

Dr. Robert T. Morris, of New York City, after testing aristol in the hospital of the New York Presbyterian Graduate School, says: "It seems after a careful series of experiments that it is superior to iodoform in all classes of surgical cases, in which the former was applied," and Dr. Manley, of the same city, in an article published in the *New England Medical Monthly*, takes about the same ground. The case referred to was that of a little boy, Tommy H., aged 9 years, who had met with a frightful laceration of the left leg. He was with a mate playing on a flat car in the yard of the Housatonic R. R. Co., in the city of Danbury. The car was isolated on a side track, and the boys were running and jumping on and off, dancing on the platform and the like. After a while they tired of their exercise, and seated themselves on the end of the car with their feet hanging over it. Without warning and without being seen by the employes, a car loaded with lumber was backed up to the side track. This car was loaded with loose lumber and over the front the irregular ends

protruded. Before the boys realized their danger the car was upon them, and some of the projecting boards caught Tommy's leg. It was almost immediately released, and the injured boy taken to his home while I was sent for. On my arrival I found on a superficial examination that his injury was a very severe one, and that it was advisable to have him taken to the hospital, especially as his home was a poor one, which was done. On arrival at the hospital, he was given ether and a careful examination was made, with the following result. It was found that almost all of the soft parts of the leg were fearfully lacerated, and that the tibia had sustained a transverse fracture. It did not seem that it would be possible that his leg could be saved, but remembering that children have wonderful recuperative as well as reparative power, I determined to make the effort. All of the macerated tissue was carefully dissected, trimmed away, and the wound carefully cleansed. Then the torn ends of the muscles were coaptated as well as possible, the tendons united, and the integument replaced as much as was possible. Of course all of this took a long time, and was done with full antiseptic precautions, and the suturing was made with catgut. The integument was so badly torn and lacerated in some places that it had to be trimmed, and there were some bare spaces. The whole of them was covered with a heavy coating of aristol, enveloped in antiseptic cotton, and put up in a plaster of Paris bandage, setting the fractured

bone at this time. This dressing was not removed for one week. There was no elevation of temperature, and the boy required very little anodyne to keep him quiet.

On the removal of the dressing at this time it was found that a most wonderful metamorphosis had taken place. Union had been established over a considerable extent of the integument, and all of the tissues beneath seemed to have united firmly. There was simply no odor to the wound, and quite firm bony union had taken place. Over the spaces which were denuded of the integument healthy granulations were springing up all over, and the prospect was very bright for saving the limb. It was washed off carefully with bichloride solution, one to two thousand, aristol freely dusted on, and plaster of Paris again applied as before, leaving windows for the purpose of frequent dressing of the denuded parts. This was left on for one week more, when it was found that union in the bone was so firm that the plaster of Paris splint need not be further used. It was dressed as before, and this treatment continued for another week when all was perfectly healed, and in four weeks from the time of his entrance into the hospital he was discharged cured. When we take into consideration the extent of the injury to the soft parts, I am sure that you will agree with me that this result so readily attained was little short of the marvellous.

The next most gratifying case in which I used it was that of James A., who was suffering from

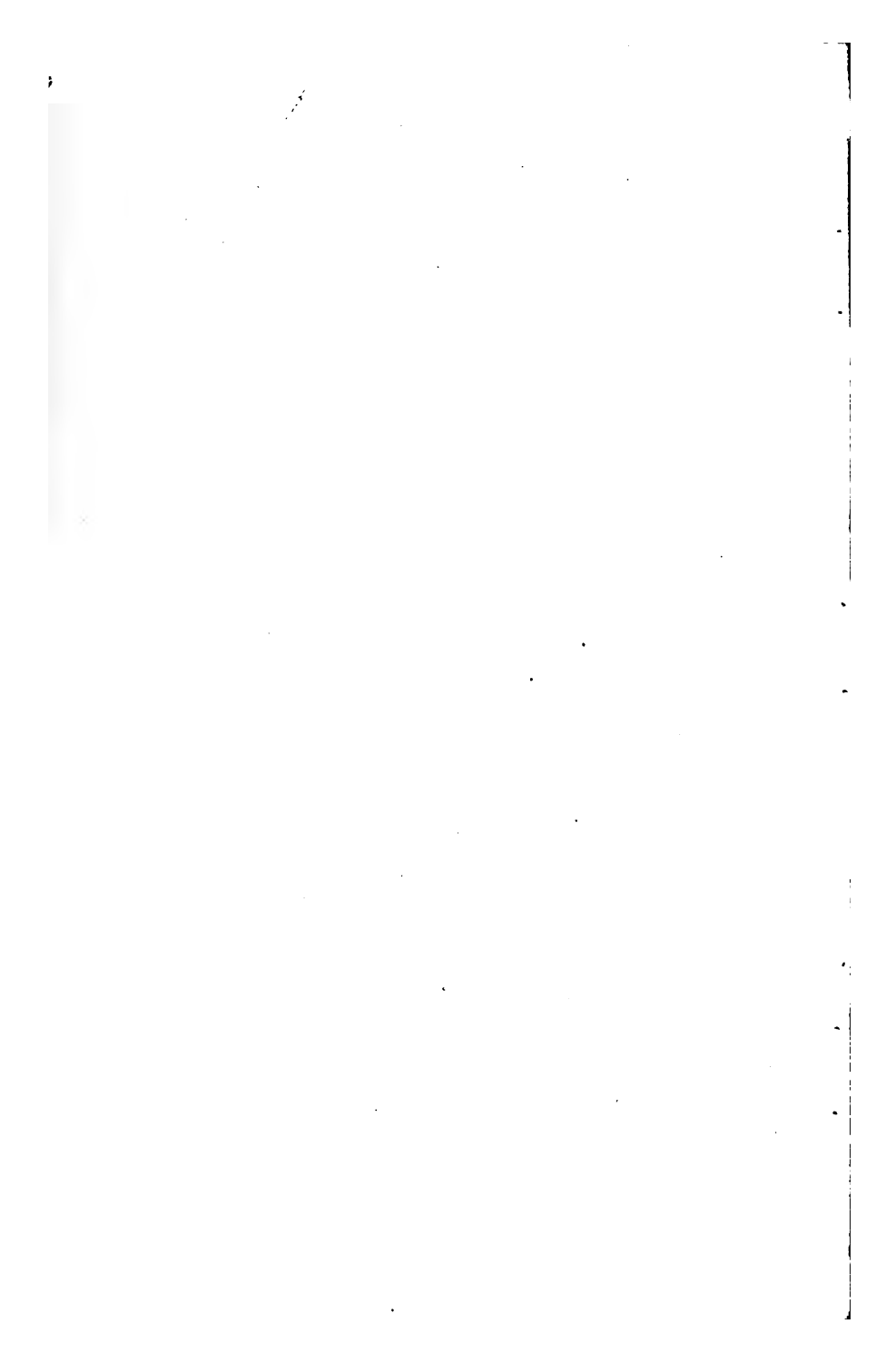
a very large specific bubo which was gangrenous in its character. He had been under the charge of several physicians, and his life seemed to hang by a single thread. The cavity was well washed with Marshland's peroxide of hydrogen and packed with aristol. This was renewed every day and the bubo not only rapidly healed, but the general condition of the patient immediately improved. All the internal medication I gave was a dessert-spoonful, three times a day, of the elixir of three chlorides, and a generous diet.

I have used it in varicose ulcers of the leg with the most charming results. In this troublesome affection I firmly believe that no other treatment will bring about such gratifying results as aristol and the rubber bandage. Its effect is immediate and rapid.

A little girl was horribly burned on both legs from her clothes catching afire. The fire was quickly extinguished, but the burns on the limbs were very severe, extending to the second degree. I made an ointment of aristol one drachm to lanolin one ounce and a half, and spread it thickly over the whole inflamed surface. The limbs were then put up in absorbent cotton, and roller bandage, which was not taken off for one week, when it was found that the whole surface had healed, except two places the size of hen's egg, which subsequently healed under a few dressings. I have used it in five other cases of this character with equally good effect.

In recent wounds resulting from traumatism

of any character it is probably seen at its best. Its action is peculiar. Take a given wound which has been carefully cleaned by antiseptic methods, stitched together, and aristol dusted on the surface; when the next dressing is made the following will be observed: There has been no exudation. The aristol is as dry as when it was first put on. The wound is also as dry, or even dryer, for where there was a particle of moisture the aristol had sealed it in, as it were; and the wound had healed while perfectly dry. I have never seen a case of injury which was treated by aristol that did not heal perfectly and entirely, provided I had been careful to make it perfectly aseptic prior to its application. In conclusion, aristol has many advantages over iodoform, inasmuch that it is perfectly non-poisonous, has no odor, does not irritate, is fully as good an antiseptic as iodoform, and in our opinion the ideal one.



LINEAR CRANIOTOMY (MISCALLED CRANIECTOMY) FOR MICRO- CEPHALUS.

BY W. W. KEEN, M.D.,
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I have entitled this paper "Linear Craniotomy" instead of "Craniectomy," the word proposed by Lannelongue and formerly used by myself. The operation is practically a long incision in the skull, the removal of a part of the bone being merely incidental to its being a hard instead of a soft tissue. The termination "ectomy" usually and of right signifies the entire removal of the part preceding this termination, *e. g.*, oöphorectomy, omphalectomy, nephrectomy, etc. Removal of the cranium (as craniectomy means) being scarcely intended or done, our nomenclature should fit the facts. Dr. Bauer uses the word craniotomy in reference to his case (see below), but trephining is, I think, the proper one to describe his operation.

In *The Medical News* of November 29, 1890, I published a case of linear craniotomy for micro-

cephalus. The object of the present paper is to report the later history of this case and two additional cases that I have had, as well as brief notes of one kindly furnished me by Drs. B. Sachs and A. G. Gerster, of New York, and another similar furnished me by Dr. J. C. McClintock, Professor of Surgery in the Kansas Medical College, making with Lannelongue's two cases and Wyeth's case, eight in all that have been done so far, and to refer to two other cases done before my own, for the same disorder and with the same intention, but by methods which I cannot think should be classed as craniotomies.

Case 1.—(For earlier history see *The Medical News*, November 29, 1890.) Since the operation this child has certainly improved steadily and considerably, but not at all to the extent of the case reported by Lannelongue. She screams almost none at all, sleeps better, notices a watch when held before her, observes things about her, and has used a number of words, occasionally but not constantly. She drools and screams but little and has almost lost the restless wringing of the hands which was so marked a peculiarity before the operation.

February 17, 1891. A precisely similar operation to the first was done upon this patient at the Jefferson Hospital. The improved forceps enabled me to do it in thirty-five minutes instead of an hour and a quarter. She was entirely well in five days. No drainage was used.

March 24. The child is slowly improving. I do not see that her progress has been any greater since the second operation than before.

Case 2.—K. K., girl. Patient of Dr. F. X. Dercum.

Condition, May 23, 1890.—Age 1 year (when first brought to Dr. S. Weir Mitchell at the Orthopædic Hospital and Infirmary for Nervous Diseases). Very small. Makes no attempt to walk or sit; moves arms well; feet and hands cold; muscles flabby. Circumference of head $14\frac{1}{4}$ inches; diameter, biparietal, 4 inches; occipito-frontal, 4.5 inches. Knee-jerk slight, sensation good, no clonus, no rigidity. Fontanelle closed. Nose-bridge very wide. No mental development; hearing and vision good; does not speak at all; disposition good. Passes water and stools without notice. Spine straight. Five teeth. A general restlessness comes on at times; usually excessively cheerful.

Both parents alive and well. Father and mother are first cousins. No venereal history; no consumption in the family history except a sister of the father who contracted consumption. The mother has been married five years and has two children, of which the patient is the younger. Her brother is 4 years of age, and is strong. He was breast fed; is hydrocephalic; circumference of head 53.3 cm.

The patient was born at term. Labor lasted twenty four hours and was very hard. No instruments were used. Patient was very small in

size. No palsy, but very weak. No fontanelle existed at birth and her head has not grown since, though her body has. She was breast-fed for three months, and since then bottle-fed. She had a cold in her head for six months.

Condition, December 1—Nineteen months of age. Cannot sit alone; constantly in motion; 12 teeth. Circumference of head 36 cm. ($14\frac{1}{4}$ in.). Biparietal, 10.3 cm. ($4\frac{1}{8}$ in.); biauricular, 10.2 cm.; bitemporal, 8.3 cm. ($3\frac{1}{2}$ in.); occipito-frontal, 11.9 cm. ($4\frac{3}{4}$ in.). Circumference of chest, 38.2 cm. ($15\frac{1}{8}$ in.). Height, 69.8 cm. (27.5 in.). Weight 12.5 pounds. [I append the following normal measurements at birth from Schröder's *Lehrbuch der Geburtshülfe*: Length 50 cm. Head, bitemporal, 8 cm.; biparietal, 9.25; occipito-frontal, 11.75 cm.; circumference, 34.5 cm.] Top of head quite prominent. Can hold things in her hand; cannot feed herself. Moderate contraction of flexors of both feet; legs not paralyzed, knee-jerk absent, no ankle clonus. In repose idiotic expression. Frontal lobe retreating. Two convulsions this summer, two last winter, each time with teeth. Has the expression of a precocious idiot. Attention can be won, but only momentarily. Mind and eye flit from one thing to another quickly.

Operation at the Infirmary December 3, 1890.—An incision was made one inch to the left of the middle line, parallel to the sagittal suture and six inches in length. A curved incision was then made from the anterior end of this line

downward so as to lift a frontal flap, the scar of which would be hidden by the hair. A half-inch button of bone was removed by the trephine, and from this anteriorly and posteriorly a furrow a quarter of an inch wide was cut out of the bone, extending to within an inch of the supra-orbital ridge and an inch above and to the left of theinion. The length of the furrow was five inches.

The amount of hæmorrhage from the scalp was very slight, much less than I have found it in adults. The bone was very thin, about one to one and a half mm. only, but bled freely. Opposite the parietal boss the dura was very adherent to the bone, but at all other points was separated easily. When the point of a pair of scissors was put under the flap of bone thus loosened and the handle of the scissors let down gently, the simple weight lifted the flap perceptibly. The periosteum corresponding to the bone removed was cut away. The dura had not been opened, and appeared normal.

A few strands of horsehair were placed in the furrow and the wound dressed. The operation lasted half an hour. Temp. at its close 98°.

13th, (10th day). The wound healed kindly and quickly, and in five days the stitches were out. During the process of healing the child showed unusual fluctuations of temperature, the highest being, however, only 100.8, for which no apparent cause could be found. After keeping the child a few days longer in the hospital to be sure of a safe

recovery she was sent home to-day. The attendants at the hospital are decidedly of the opinion that she is quieter and calms at her head much less than she did before the operation, though for myself I can scarcely see much difference.

March 2, 1891. The child has improved very much in general mental condition, but not so rapidly as I could wish. Accordingly, to-day I did a linear craniotomy on the other side of the head in precisely the same manner as the former operation. The operation was wholly completed in twenty minutes by the new forceps.

24th. The evening of the operation her temperature suddenly rose to 104.6° , falling to normal in four days. The rise in temperature was of course too sudden and too great to be the result of the operation. The cause of it was soon discovered to be a marked intestinal disorder which had begun the day before the operation. This fact was not communicated to me by her mother. No drainage was used and the wound was entirely well and the stitches out in five days. Her progress is very much the same as in case 1.

Case 3.—J. L. H., male, aged sixteen months. Was first seen by me on January 10, 1891. In the fifth month of her pregnancy his mother's friendly sympathies were deeply stirred by seeing the dead baby of a friend, and the seventh month of her pregnancy she was startled by being nearly run over. Her labor was normal, lasting three hours; no instruments were used. The

child's weight was between seven and eight pounds. The anterior fontanelle was very small at birth and closed at or before seven months of age. The child was breast-fed for three weeks and after that bottle-fed. At about three weeks, six weeks, and three months of age had one or more convulsions. He was very peevish and fretful up to twelve months of age, but of late has been much less so until some recent trouble, presumably his teeth. His parents state that he was a "blue baby" for a year, but Dr. S. Striker, his physician, informs me that it was not discoloration due to a patent foramen ovale, but a constant and very marked mottling of the skin from defective circulation. The child has had attacks of very poor circulation, but of late these have diminished very much. He has also been subject to attacks of apparent pain and of restlessness continuing for a day or two.

Status Præsens January 10, 1891.—A well-nourished, apparently hearty boy; no contracture or other deformity excepting his head. Viewed in front the skull is markedly conical, face broad, top of skull narrow and arching. Circumference on the shaven scalp, 38 cm. (15 in.). Diameters: Occipito-frontal, 13.5 cm. ($5\frac{1}{8}$ in.); biparietal, 9.8 cm. ($3\frac{7}{8}$ in.); bitemporal, 8.6 cm. ($3\frac{1}{8}$ in.). The child drools all the time, has never attempted to stand, falls unless held up, and scarcely even holds his head up. He has never talked. He moves his extremities, but very sluggishly; moans a little, sleeps poorly; head and eyes commonly

turned to the left and upward, except in the attacks of apparent pain, when they go to the right, and, as his father expresses it, "he twists himself all up." These attacks are not epileptic in character. He yawns often. His attention can be attracted, but with difficulty, and only for a moment. On shaving the head, the broad furrow behind the coronal suture is very marked, and the occiput protrudes posteriorly much more than usual.

Operation, January 16.—Present, Drs. Striker, J. C. DaCosta and Mills. Dr. W. J. Taylor, as usual, assisted me. I thought that the child's circulation had at times been so impaired, that especial care was necessary in administering the anæsthetic, so I requested Dr. Coplin to give the ether, on account of his large experience in the Jefferson College Hospital. After the same method as in my former cases, I cut a groove $\frac{3}{4}$ of an inch to the left of the middle line, reaching from $\frac{3}{4}$ of an inch above the supra-orbital ridge well back, nearly to the inion. Its length was $6\frac{3}{8}$ inches. In biting the bone I used a pair of forceps devised by me for the purpose, which answered admirably, so that instead of an hour and a quarter as in my first case, and fifty minutes in my second, I did the operation in thirty minutes. The bone bled quite freely, but not alarmingly, and the bleeding stopped spontaneously. No other incident occurred during the operation, except that the child's breathing at one time was sighing, and he had apparently, about the same

time, a slight convulsion. There was tremor of the extremities during the operation. At no time was he deeply anæsthetized. Shortly after the close of the operation I left the child in its crib, in charge of a competent nurse and the mother. He was slightly pallid, but no more so than one would expect after an operation, and there was nothing in the respiration or pulse to cause anxiety. Dr. Taylor did not leave the house till an hour after the operation, when the child's pulse and respiration were entirely satisfactory. An hour and a quarter after the close of the operation, the child gave a few gasps and died instantly, presumably from heart failure. It had not recovered consciousness after the operation. No post mortem examination could be obtained, in spite of the most earnest efforts.

Case 4 (Gerster and Sachs).—A. F., female, aged $4\frac{1}{2}$ years; labor normal, first child; began to walk after the age of 2 years; in third year began to speak a few words, but these she would use properly. When 13 months old had measles. At 15 months two distinct convulsive attacks, without paralysis. Other convulsive attacks at the age of 22 months and 29 months; none since. After these attacks grew more idiotic; lost what little speech she had, became unruly, fretful and ill-tempered; slept little. The fontanelles had disappeared. The measurements taken on shaved head were: Circumference, 31 cm.; fronto-occipital, from root of nose over top of head to occipital prominence, 30 cm.; biauricular, $32\frac{1}{4}$ cm. The

child was operated under chloroform, the period of anæsthesia lasting not more than fifty minutes; linear craniotomy was done on the left side, from in front of the position of the coronal suture and beyond the lambdoidal suture. The opening in the skull was semicircular. The child's pulse was weak as soon as chloroform began to act; recovered nicely, however. Soon after operation was conscious, and pulse rallied. Without further accident child died suddenly, three and a half hours after operation, from acute anæmia.

Case 5.—In the *New York Med. Record*, February 21, 1891, Dr. Johh A. Wyeth reports a case of a male child, 11 months old, operated on by a median incision of the scalp from the nose to the occiput. Two lateral trenches, $\frac{1}{4}$ of an inch wide and $\frac{3}{4}$ of an inch apart, were made from just above the eyes to the occipital protuberance. At each end a transverse cut was made in the bone on each side, and a similar transverse cut on each side at the middle. By the fingers these four bone flaps were then forcibly torn loose from the dura mater, widening the trenches from $\frac{1}{4}$ of an inch to 1 inch each. No injury seems to have been done to the dura. Time required, an hour and a half. Wound well without incident in ten days. A month later the improvement was "surprising and gratifying." The intelligence had greatly increased.

Cases 6 and 7.—Two cases reported by Lannelongue in *L'Union Médicale*, July 8, 1890, and of

which a *résumé* appears in my clinical lecture in *The Medical News* of November 29, 1890.

Case 8 (Dr. J. C. McClintock's case).—A girl, aged 3 years and eight months, although appearing to be not over one year of age. Premature birth at eight months; no instruments. Anterior fontanelle closed very early. Totally blind; not the faintest signs of intelligence. Two years ago the orbital plate of the frontal bone on the right side gave way, displacing the right eyeball from the orbit. The knee-joint became very painful a few months ago, and the arms and lower limbs contracted. Right tibia and fibula and left femur curved. Head narrow, forehead low. Linear craniotomy (March 28, 1891), on each side of the longitudinal sinus, with lateral grooves at the two ends. The tips of the fingers were then passed into the grooves, and the bones spread on each side until the quarter-inch grooves became an inch wide. The dura was not opened. Next morning the temperature was 103° , with rapid pulse, but soon subsided to normal. Entire union at the end of a week. The time is too brief as yet to judge of the result, but Dr. McClintock reports that the mother says that "since the operation the child is not so restless, does not cry nearly so much, and has required much less care and attention. The extremities are not so tender, and the child will try to play with any little article that is given to it." Before the operation she could only lie on one side; now she will lie on either side. The paralysis has almost dis-

appeared, so that the left hand is used almost as readily as the right.

In considering these cases one is struck by the fact that two of them were followed by speedy fatal results. I presume it is only to be expected that children of such feeble cerebral development accompanied as in my own case (Case 3), with faulty circulation, should be less rugged and less able to stand the shock of an operation. The cause of death in my own case was very clearly, I think, heart-failure, and in Sach's and Gerster's case it was acute anæmia. This mortality, which is quite unusual of course in ordinary brain operations, should induce us to state the risk to the parents in stronger terms than we would were it an ordinary case of trephining. For myself I cannot but think it a very fortunate thing, for if such children cannot be helped it seems to me that death is preferable rather than to linger in this world in such defective and helpless condition.

It should, however, make us especially careful as to the administration of the anæsthetic and we should use all possible means to shorten the operation as much as possible. The forceps I devised for the operation certainly answer the purpose very much better than those I first used, so that the time required for the last operation was only twenty minutes, instead of an hour and a quarter as in my first. In using them it is better to cut alternately a little to the right and left (as one turns his toes out in walking) to prevent their

binding. It will be noticed that the upper blade is perforated. This perforation widens from the cutting edge upward, so that each piece of bone bitten out pushes its predecessor loose. In a recent case of spinal laminectomy I used the same forceps to remove the vertebral laminae, and I found them far superior to any of the other instruments I had on hand, and tried in turn.

I have not yet operated on both sides of the skull, and in view of our present experience I certainly would deprecate a simultaneous operation on both sides. Probably the additional shock would be very unwise and would add greatly to the mortality. Whether two lateral operations done successively will improve the condition of such children more than one remains to be seen. The results as to mental condition in the six cases that have survived may be stated briefly as follows: Lannelongue's second case was reported almost immediately, too early to judge of any results. So too of McClintock's case. In the other four children there can be no question of improvement, very rapid in Lannelongue's case, slower but sure in both of my own and in Wyeth's case. We have, therefore, I think, sufficient reason to encourage us to operate in other cases, and it is this fact, and the fatal result in two, which has led me to report my cases so early, before the final results are obtained. This will require several years, and meantime we ought to make known the immediate results as a guide in other cases.

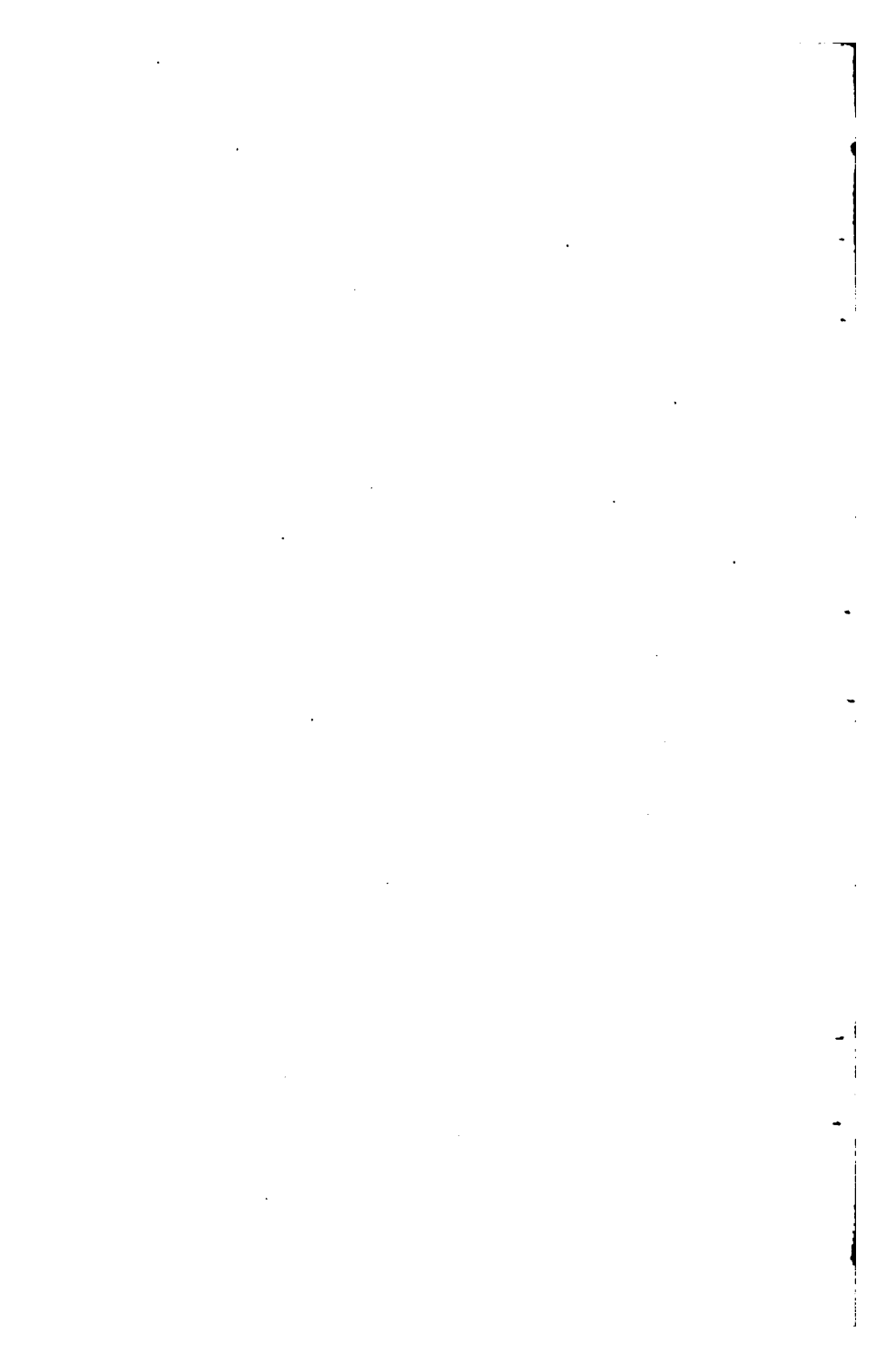
In the *St. Louis Clinique of Physicians and Surgeons*, April and May, 1890, Dr. Louis Bauer reports the case of a young woman on whom he did a craniotomy for microcephalus. Her age, the measurements of the head and the date of the operation, are not given. Two buttons were removed from the right parietal bone, and the intervening bridge chiseled away. On May 9, presumably 1890, a second operation was performed, on the opposite side of the skull. Prior to the operation there was spastic paresis of the muscles with great tremor, which after the first operation had so diminished as to enable the patient to thread a needle. There is no statement as to mental condition. She recovered from the second operation, but it is too early to judge definitely of results.

In *The Medical News* of January 3, 1891, Dr. Trimble, of Baltimore, reports the case of a child, 3 years of age, whom he trephined on November 8, 1890. On the right side of the middle line two buttons of bone, 1 inch in diameter and $\frac{1}{2}$ inch apart, were removed, so that the opening measured $2\frac{1}{2}$ by 1 inch. Some improvement was noted on December 6, 1890.

I have not included these cases under the head of linear craniotomy, since it seems to me that they should be considered simply cases of trephining for microcephalus and idiocy, as has previously been done by Fuller and others. The essential difference between trephining and linear craniotomy is this: that in linear craniotomy the

intention is to make the entire side of the head a *bony flap*, as it were, whereas the trephining in the cases alluded to simply removed two buttons of bone and the intervening bridge, and so produced a difference in pressure and possibly allowed, simply at the point of trephining, a little bulging of the brain itself. As to the results, so far as the brief time in all the cases will allow us to judge, they seem to be quite as good after trephining as after linear craniotomy proper, and if so, it may be a matter of indifference which is done. But at the present time it seems to me more logical to do the craniotomy than the simple trephining.

The operation of Wyeth seems to me unwise, and likely to be followed by a fatal result in more cases than if the less heroic method usually employed is followed. Even this has resulted in two deaths already, and if a double operation is done and the two sides of the cranium are forcibly separated, the danger would seem to be far greater. The dura might easily be torn, especially as it is so adherent in children. Moreover, the brain cannot suddenly follow the widening bone, but must be persuaded, as it were, to occupy a larger room by favoring its gradual growth. This, I think, is better obtained by the process I have followed than by Wyeth's method. The same remarks apply to McClintock's case.



THREE CASES OF EPITHELIAL GRAFT-
ING FROM THE HORNY EPIDER-
MIS, WITH REMARKS.

BY C. B. KIBLER, M.D.,
OF CORRY, PA.

Practical example is always in advance of theoretical precept, and so in this paper we will present in practical work, to demonstrate the operation, technique, material used, and clinical results in a few cases of what doubtless is a new and novel procedure in epithelial grafting. Appreciating the fact that the researches of Reverdin, first announced in 1870, of the transplanting of small particles of skin to a raw or granulating surface, and the wonderful excellent results obtained by many operators by this method since then, as well as the most admirable results obtained through the method of Thiersch and others by removing long strips of skin from the thigh or arm and applying to much the same condition of surface as that of Reverdin, has to a greater or less degree superceded the method of the former and made the raw ulcerating surface of the past

a thing not to be dreaded by the surgeon of the present day, as it many times was the surgical approbrium of the last decade. There is no question of doubt but to America belongs the credit of first advancing the idea and technique of skin grafting. The late lamented F. H. Hamilton, that master mind, who was always in the advance guard of improvement in American surgery, in 1854 successfully transplanted skin to a raw surface. He had, however, seven years previous, in 1847, advanced the idea but failed to apply it to use until later on. We will not burden the Section with reviewing the history and the great achievements attained in the past upon this subject, but will detail briefly the object of this paper.

Case 1.—In October, 1889, J. L., a lad of 12 years, in attempting to jump from a moving freight train, had the soft and bony part of his right hand crushed under the wheels. Efforts were made to save the hand, but some five or six days afterwards I was called in to amputate it on account of sloughing. The thumb retaining some life, the hand was disarticulated at carpo metacarpal joint, leaving a stump of 24 square inches entirely devoid of skin. His mother earned her daily bread as a washerwoman. Her hands, from her daily avocation, became much calloused, and it was from this thick and indurated epithelial tissue that I obtained what proved to be most excellent material for grafting. Small pieces, about one line square, very thin, in fact

not much thicker than tissue paper, were sliced with a sharp scalpel from the callosities of the palmar surface of his mother's hands. The granulations were first washed with 10 per cent. solution of warm creolin water and afterwards with saline solution of sterilized water. The surface from which the grafts were to be obtained was treated in similar manner; the grafts of epithelium, about six to ten in number, were then applied to the raw surface and covered with protective, which was held in place by rubber plaster; the remainder of the wound was dusted with powdered boracic acid, and the whole covered with moist gauze over which absorbent cotton, and lastly crinoline bandage. The dressing was changed every three or four days; all dressing removed, and new grafts applied upon a new field of raw surface. About 80 per cent. of grafts adhered and formed true skin covering. One peculiarity it will be well to call your attention to, and that is, the grafts must be applied precisely as they are cut off, for if you should reverse or turn them over, they will not grow, seemingly the vitality is entirely destroyed. This hand was covered with skin in about four weeks' time.

Case 2.—My next opportunity for applying this mode of grafting, occurred shortly after the above case. Mr. K., age 63, had a tank of boiling water emptied upon his neck, back, arm, and forearm, entirely destroying 400 square inches of true skin. This was covered after the method as above related, it requiring nearly five months to

complete the cure, with very little contraction from cicatricial tissue.

Case 3.—Large indolent ulcer of left leg. Mrs. T., age 56; the ulcer was about three by six inches in size, of three years' standing, the surface of which was prepared for the grafts by denuding the surface of same with scalpel before applying the grafts; five weeks was required to complete a perfect cure, and has remained so since December last.

The advantages in this method over the use of skin, either in large or small patches, consists in the fact that there is no pain, or raw surface left upon those who furnish the material, that the supply from the hands of those whose avocation produce the callosities is daily renewed and no discomfort in any way is produced by removing the thin slices of tissue from the thickened epithelial surface, that from three to six or more grafts can be cut from the same surface every three or four days without the subject suffering the least inconvenience; at the same time it is entirely bloodless. No local anæsthetic is required, a much greater number, or percentage, of the grafts uniting than in any other method, for in my hands and others it has exceeded 80 per cent. of grafts that united and formed true skin. The abundant supply of material to be obtained at all times, without any coercion, for if it cannot be obtained from the palmar surface of the hand no trouble will be experienced in procuring it from the planter surface of the foot, where callous

epithelial tissue can be obtained from the foot of almost any person.

If I have interested you with this brief summary of my experience in this new form of epithelial grafting, and in your hands after faithful trial if it proves as complete a success as in mine, I shall feel warranted in saying that in a great majority of cases, where now other methods are used, this can be substituted.

CÆLIOTOMY (ABDOMINAL SECTION)
FOR RUPTURE OF THE PARTURI-
ENT UTERUS.

BY HENRY C. COE, M.D.,
OF NEW YORK.

Introduction.—Although the literature of this subject is quite exhaustive, most authors deal with the etiology and pathology of rupture of the uterus, rather than with the treatment, and much of the teaching with regard to the latter antedates the era of modern abdominal surgery. The writer feels some hesitation in writing upon this theme, as it has been already ably presented to the American Medical Association by Dr. Wm. H. Walker and Dr. C. A. R. Reed, in papers read before the Obstetric Section. The writer's purpose in reintroducing the subject before the Surgical Section is to have it discussed from the broad standpoint of *general surgery*. This is entirely proper, since rupture of the uterus is to be considered in the same light as rupture or other lesions of any other of the abdominal viscera. It is preëminently a *surgical emergency*, and should not be

studied from its gynecological (or obstetrical) side alone. When Lawson Tait feels justified in proposing Porro's operation as the proper treatment for placenta prævia, we may well ask: "Is simple expectant treatment applicable to the far more formidable obstetrical complication, rupture of the uterus?" Note that the paper deals with rupture of the *parturient* uterus, and not with injuries of the organ before labor. This is an important distinction, to be borne in mind in the discussion.

The writer bases his paper entirely upon his personal experience—that of four cases (seen within a period of eighteen months) in which abdominal section was performed. One case was successful, the patient being now in perfect health.

Brief outline of cases:

Case 1 (reported *in extenso* in *New York Med. Record*).—Rupture due to undue interference in the first stage (forceps and attempted version), the child being of unusual size. Operation two hours after the accident, the patient being in collapse from active internal hæmorrhage. The child's head had escaped from the rent, which extended from the cervix through the left broad ligament, half way to the fundus. Child extracted through the rent, after application of rubber cord. Uterus removed and pedicle treated by the extra-peritoneal method. On account of extensive laceration, the entire stump sloughed out, but the patient made a good recovery.

Case 2.—Cause of lesion identical with that in

Case 1. Injury not recognized until twenty-four hours after the birth of the child, when the patient was already septic. Cœliotomy. Transverse tear on posterior aspect, 4 inches long, in lower segment, with commencing peritonitis. Rent sutured, and thorough irrigation and drainage. Death from shock twelve hours later.

Case 3.—Moderate contraction of anterior conjugate, with large child. High forceps unsuccessful. Delivery after difficult version. In removing an adherent placenta the accoucheur withdrew a coil of small intestine, which prolapsed through a rent in the posterior wall of the uterus. It was replaced (as was supposed), and the opening was plugged with iodoform gauze. Abdominal section was then regarded as unjustifiable, on account of profound collapse. The writer saw the patient eighteen hours later, found her in fair condition, the upper portion of the vagina being filled with intestine. He proposed and performed cœliotomy at once. There was a transverse tear posteriorly in the lower segment, extending between the bases of the broad ligaments. It was too extensive to suture, so both broad ligaments were clamped, and the uterus was extirpated *in toto* in five minutes. It was found that the intestine had not been replaced, but had been nipped by the edges of the rent, so that at least 3 feet were black and gangrenous. Irrigation and gauze drainage *per vaginam*. Death from shock ten hours later.

[The above were private cases.]

Case 4 (Maternity Hospital). — Spontaneous rupture during normal labor, not recognized. Collapse five hours later, but no extensive hæmorrhage. The writer saw the patient twelve hours after the accident, and diagnosticated rupture of the uterus with internal bleeding. A consultation of the attending staff was held, and the unanimous opinion was that there was an extensive laceration into the left broad ligament, and that active hæmorrhage was in progress, which it was necessary to arrest. There was doubt as to whether the rent extended into the peritoneal cavity or not. Exploration advised. This was conducted rapidly. No blood found in the abdominal or pelvic cavity. There was an immense hæmatoma of the left broad ligament, extending upward into the corresponding iliac fossa. Abdominal wound closed and vagina tamponed with gauze, although *there had not been any external hæmorrhage whatever*. Death from shock.

Here follow extended references to the literature of the subject, from which and the cases reported are drawn the following inferences:

Many cases of spontaneous rupture are doubtless unrecognized by the general practitioner. Profound shock after delivery should always awaken suspicion, even if there is only moderate external hæmorrhage, and a thorough examination should be made. Text-books give rules for recognizing rupture only *during* parturition.

The rules laid down for the treatment of rupture are uncertain and confusing. The tendency

of the practitioner is toward purely expectant treatment. He would pack the vagina with gauze and wait. This course is too often fatal. The emergency is a *surgical* one, and is to be treated according to the ordinary rules of surgery.

The fact that successful cases of cœliotomy for rupture of the parturient uterus are comparatively rare, is no more an argument against the operation, than if it was applied to gunshot wounds of the abdominal viscera. In analyzing the unsuccessful cases, it will generally be found that operative interference came *too late*, *i. e.*, from eight to eighteen hours after rupture. The writer's successful case was as unfavorable as could be imagined, but the patient was operated upon promptly, as soon as the lesion was discovered. Two methods of active treatment are now recognized and practiced, viz.: 1. Drainage per vaginam. 2. Abdominal section, followed by either, *a*, drainage; *b*, section of the tear; or *c*, amputation of uterus. Simple drainage has some powerful supporters (mainly in the Vienna school), and the statistics are apparently convincing, but it is not capable of general application to all cases, and the indications are not always clear, because without opening the abdomen it is frequently impossible to determine the following important points: 1. The nature and extent of the tear; 2. The presence of active hæmorrhage; 3. The presence of blood and amniotic fluid in the peritoneal cavity. [It is assumed that the uterus has been emptied.] The writer thinks that ab-

dominal section is indicated under the following conditions:

I. Before the uterus is emptied.

1. When the placenta or *any* portion of the foetus has escaped from the rent. Attempts at manual delivery only increase existing shock and destroy the patient's chances after section, as invariably shown by records of unsuccessful cases.

2. When there is evidence of progressive internal hæmorrhage.

II. After the uterus is emptied.

1. When there is extensive prolapse of the gut through the tear (as in Case 3).

2. In all complete lacerations (especially in those involving the broad ligaments), except small tears low down, near the vaginal fornix (as in Case 2), where good drainage can be maintained.

3. In incomplete tears in which the broad ligament is extensively involved (as in Case 4), and there is evidence of progressive hæmorrhage. [This point must remain *sub judice*. Only one other beside the writer (Peters) has opened the abdomen in such a case. His patient died, and the report of the case provoked considerable adverse criticism. In the discussion before the Vienna Obstetrical Society, only Gustav Braun expressed the opinion that section was justifiable when there was no evidence of progressive internal bleeding, and it was not certain whether the tear was complete or not.] Parvin's summary is a comprehensive one, viz.:

"Probably the solution of the question is this, that where the tear is in such a position that vaginal drainage is perfect, the abdomen need not be opened; but if such drainage is impossible, or imperfect, then section is indicated."

What shall we do after opening the abdomen?

1. Arrest hæmorrhage, either with forceps or the temporary rubber ligature.

2. If the tear is small (2 inches), and is low down in Douglas' pouch, drainage per vaginam may be indicated.

3. If the tear is clean-cut, without contusion of the edges, and does not involve the cervix or broad ligaments, it may be closed with deep and subserous sutures.

4. If the tear is not low down, is extensive, with contusion of the edges, and especially if a portion of the foetus protrudes, amputation of the uterus, with extra-peritoneal treatment of the stump, is indicated. (The child can be extracted through the rent before removal of the uterus (Prêvat) or afterwards (Porro).

5. In extensive transverse tears in the lower segment (as in Case 3), and in tears beginning in the cervix and extending upwards through the broad ligament, the writer would strongly urge the propriety of total extirpation of the uterus as the operation *par excellence* (as it is in many cases of hystero-myomectomy), for the following reasons:

1. It requires less time than Porro's operation, and is quite as easy, especially if the patient is

placed in Trendelenburg's position. There should be no greater shock or loss of blood.

2. *All* the contused tissue is removed, which if left behind in the stump, will inevitably slough and imperil the life of the patient (as in Case 1).

3. Drainage is perfect. After thorough irrigation and toilet of the peritoneal cavity, it can be closed, drainage being maintained per vaginam with iodoform gauze, as after vaginal hysterectomy.

Conclusion.—The writer deprecates any intention of recommending a heroic method of treatment to the entire exclusion of the more conservative. He is an avowed conservative in abdominal surgery, but believes that rupture of the parturient uterus is a desperate emergency, in which a fatal issue is the rule, and that it requires prompt and energetic treatment according to the rules of modern surgery. The fact that the statistics of coeliotomy in these cases have shown a large mortality, is not an argument against the operation. In every case the accoucheur, if not himself a surgeon, should without an instant's delay summon experienced counsel, and explain to the family that immediate resort to abdominal section may be necessary. Only by prompt interference can we improve statistics, and thus elevate the operation above the level of a hopeless and, apparently, unnecessary surgical experiment.

THYROIDECTOMY.

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In discussing the surgical treatment of goitre or bronchocele I propose to do it in a concise and practical way, basing my remarks largely upon the results of my own experience, and therefore will not deal with it from a statistical, theoretical or classical point of view.

Goitre or bronchocele is met with as one of three varieties: Fibrous, cystic, and pulsating or vascular; which latter variety, where associated with exophthalmus not being, except in a few cases, amenable to surgical interference, I will not discuss. Of the fibrous and cystic varieties it is not uncommon to meet with these two conditions present in the same case, thus forming a fibro-cystic goitre. Secondary changes, such as the substitution of gelatinous or colloid material for the albuminous, and calcification

in the walls of the cysts, and in the fibrous tissue, may modify the variety or form of the goitre.

The surgical treatment of goitre embraces injection, electrolysis, incision and drainage, ligation of the thyroid arteries, division of the isthmus or middle lobe, thyroidectomy, and removal (enucleation).

Indications.—In considering the indications for operative treatment, the character of the goitre matters but little, the latter having a much more important bearing upon the character of the treatment. If the treatment usually employed, viz., the exhibition of alteratives, fails to afford relief, the following symptoms constitute indications for operative interference :

1. Tracheal stridor.
2. Dyspnoea.
3. Dysphagia.
4. A rapidly growing goitre, particularly when in a downward direction.
5. Deformity occasioned by the presence of the tumor.

Tracheal stridor, a prominent and distressing symptom in many cases of large goitre, the result of pressure upon the inferior or recurrent laryngeal nerves, calls for reduction or removal of the growth. The former is practically feasible only when the growth is to a great extent cystic. If the growth be purely vascular, sudden suffocating dyspnoea may be brought about by fright; in fact, anything exciting the circulation, thus occasioning increase in size of the

swelling, which by pressure upon the trachea, coupled with the contraction of the muscles which depress the hyoid bone and larynx, may cause almost immediate death. Tracheotomy under such circumstances would be anything but an easy operation.

To illustrate the force of my remarks, and especially the part the muscles may play, I cannot do better than refer to a case reported by Dr. Dewes in the *British Medical Journal* for 1879. The patient referred to was found by the Coventry police, apparently dying of suffocation; and on his admission to the hospital a large goitre was found, and a free median incision was made down to the tumor. The dyspnœa was immediately relieved. Upon the evening of the seventh day the dyspnœa returned, the tumor again enlarging, the patient dying in a few minutes. The autopsy showed that the posterior part of the tumor had broken down, allowing a large extravasation of blood which pressed upon the pneumogastric nerves. Here tracheotomy was out of the question, owing to the cervical portion of the trachea being entirely covered by the tumor.

Extravasation may take place suddenly into a goitre resulting in the formation of a large coagulum. . Difficulty of deglutition may be caused by either unilateral or bilateral pressure upon the œsophagus, the symptoms thus occasioned simulating those of stricture.

Enlargement, if the tumor is increasing in a downward direction, is especially to be feared, and constitutes a strong indication for interference, as even tracheotomy, with the sole view of offering temporary relief, may be impossible, particularly if such a patient should be the subject of sudden dyspnoea.

Radical operative treatment in the case of a goitre which has been subjected faithfully to both internal and external treatment with no effect, not causing any discomfort other than that of deformity would not, I dare say, be in accord with the opinions of the majority of surgeons.

I believe that if such a subject is of suitable age, in good general health, and especially if there is deformity of the neck, thyroidectomy is justifiable if the goitre is unilateral. Where the entire thyroid is involved, constituting a huge mass, I think it is better to make a complete division of the middle lobe (isthmus), having previously ligated upon either side of the point of the proposed incision.

In the case of singers suffering from a small goitre, where the enlargement has taken place in direction of the groove, between the trachea and the oesophagus, the site of the recurrent laryngeal nerves, and which does not yield to treatment, I am inclined to advise removal. The first evidence of nerve irritation is most likely to be huskiness of the voice, therefore here, as elsewhere, relief of pressure for fear of irremedial injury of the nerve or nerves suggests itself.

DIFFERENT OPERATIVE PROCEDURES.

I will speak of the different operative procedures in the order I have given them in the early part of the paper.

Injection.—The injection of any material with the idea of exciting inflammation short of producing suppuration is both a painful and likely to be a prolonged procedure and is not certain to procure favorable results; it is one, too, which may be followed by suppuration. The injection of any material with the idea of exciting suppuration and consequent disintegration was, before the days of antiseptic surgery, probably the best treatment at our disposal. The position it holds to-day is a far different one. The first objection to be urged against it is its provoking suppuration. Suppuration in a structure like the thyroid gland, where absorption is so soon to follow with its train of septic symptoms, cannot be regarded as desirable. The injection of any astringent liquid into the parenchyma of a goitre is attended by some immediate risk of a coagulum finding its way into the circulation and causing embolic obstruction.

Electrolysis in certain purely fibrous goitres is unquestionably curative. (See paper by Dr. Jas. Henrie Lloyd, Trans. College of Phys., Philadelphia, 1890). Therefore in cases of this character coming to me for operation, and where the usual treatment, excepting electrolysis, has been given a fair trial, unless there are urgent symptoms demanding immediate and radical re-

lief I advise treatment by the galvano-puncture before doing anything more radical.

I am one who believes that electricity has a place in surgery but, to be given properly, by which manner good results are to be obtained alone, it must be given by one thoroughly familiar with the subject both practically and theoretically. It is not to be wondered at that so much is said against electricity as it is so often applied by those who know but little about its practical use. The requirements for one who uses the galvano-puncture, I should say, are

1. Capability in the selection of the cases.
2. A complete knowledge of the subject of electricity.
3. Practical experience in its use.

In cystic and vascular goitres electrolysis is not only useless but may be harmful.

Injection and Drainage.—Injection and drainage, done of course antiseptically, where thyroidectomy is for any reason contra-indicated, offers, in my judgment, the best treatment for goitres which are purely cystic, or those which are fibro-cystic and when the cystic element predominates; I believe the operation should be done with the patient anæsthetized and not with the use of cocaine. The goitre is to be exposed by a careful dissection, the cyst opened and the walls stitched to the integument. The cyst is now to be thoroughly irrigated with a solution of bichloride of mercury, a drainage tube introduced into the cyst cavity, the latter packed

with iodoform gauze and the wound dressed antiseptically. The details in carrying out antiseptics are to be adhered to most strictly.

In the fibro-cystic goitre where the cystic element is quite as prominent a feature as the fibrous, this treatment will be found in many instances to be followed by degeneration of the fibrous element.

Ligation of the Thyroid Arteries.—After a trial in the ligation of the superior and inferior thyroid arteries it is still an open question if much is gained by this treatment. Certainly in medium size goitres, particularly of the unilateral variety, the ligation of the thyroids is almost as much of an operation as removal, and one, I should say, quite as difficult. I can scarcely see the feasibility of this procedure, except perhaps when done in connection with division of the isthmus or middle lobe.

Thyroidotomy.—Thyroidotomy, division of the isthmus or middle lobe between ligatures, I believe to be advisable when the tumor is very large and involves the entire gland. The experience Mr. Sydney Jones (see *Lancet*, November, 1883), has had with this operation is, to my mind, quite sufficient to recommend it.

Excision of the thyroid gland, an old operation dating back to the time of Albucasis, has been and is at the present time regarded as a procedure attended by great risk, both so far as the immediate and the remote dangers are concerned.

The immediate dangers of the operation are

shock, hæmorrhage and injury to the recurrent laryngeal nerves. The remote danger is regarded to be chiefly myxœdema. My experience with thyroidectomy has been confined to the removal of unilateral goitre, and in none of which cases has myxœdema followed. I must confess I would be apprehensive of this sequel in the removal of the entire thyroid. There is a wide difference of opinion among operators as to the proportion of cases in which it has been seen to follow complete thyroidectomy. That myxœdema will occur after complete removal of the thyroid gland there is absolutely no doubt, for this has been proved both by recorded cases, also by the exhaustive experiments of Mr. Victor Horsly. I cannot feel other than that there are but few cases where the operation of complete removal of the thyroid gland would be justifiable, believing as I do that thyroidotomy would suffice. Certainly thyroidotomy should first be done, or at least attempted, when if this fails to offer relief, complete thyroidectomy may be entertained.

TECHNIQUE OF THE OPERATION.

The essential points to be observed in the removal of either a unilateral or bilateral goitre are

1. A clean exposure of the proper capsule of the tumor.
2. Not to open the capsule.
3. Securing the superior and inferior thyroid

arteries between two ligatures close to their point of entering the gland.

4. The avoidance of injury to the recurrent laryngeal nerve or nerves, both when exposing the inferior and superior thyroid artery and in the separation of the growth posteriorly.

5. Tying the pedicle by transfixion with a strong aseptic silk ligature. If the dissection has been a clean one there is no occasion for the use of drainage. For closing the wound I prefer the continuous aseptic silk suture.

Case 1.—Miss A. V., aged 24, school teacher, was admitted to the surgical wards of the German Hospital, June 22, 1887, with a fibro-cystic goitre the size of one's fist involving the right lateral lobe of the thyroid gland.

She first noticed it six years previous—it has gradually increased in size and at the time of admission was giving her a great deal of trouble in swallowing, as well as by paroxysms of dyspnœa. Superficial veins were much enlarged from pressure, growth was movable showing no evidence of adhesions. She was anæmic, otherwise her general health was good. For the past year it had troubled her so much that it was necessary for her to give up teaching, as talking for any length of time excited attacks of dyspnœa. Operation June 23. Growth found to be fibro-cystic, which was easily removed. The wound healed rapidly and patient was discharged well July 13, 1889.

Case 2.—F. L., aged 43. Laborer. Large fibro cyst in goitre of right lobe of thyroid, be-

gan to form twelve years ago. At the time of admission to the hospital patient was suffering with dysphagia and dyspnœa. Growth was dissected out. Many vessels were tied with catgut. Union by first intention; patient made a good recovery.

Case 3. — Miss A., age 35. Occupation, teacher; came under my observation in the summer of 1890, presenting a tumor of the left side of the neck extending from the angle of the jaw above, to the clavicle below, inward to beyond the median line of the neck and posteriorly to beyond the outer edge of the sterno-mastoid muscle and riding over the large vessels. The middle of the anterior surface of the tumor presented a depressed cicatrix. This growth had been present for several years. Two years ago it was much larger; when it was tapped and a quantity of clear fluid drawn off, and the sac injected with a tincture of iodine. Prolonged suppuration followed the tapping, ending finally in the obliteration of the sac. The growth, which was fibro-cystic in character, now became fibrous as a result of the elimination of the cystic element. My diagnosis was a fibrous goitre involving the isthmus and the left lateral lobe of the thyroid gland. The patient was prompted to seek further relief for the following reasons:

1. On account of chronic hoarseness which at times amounted almost to aphonia.

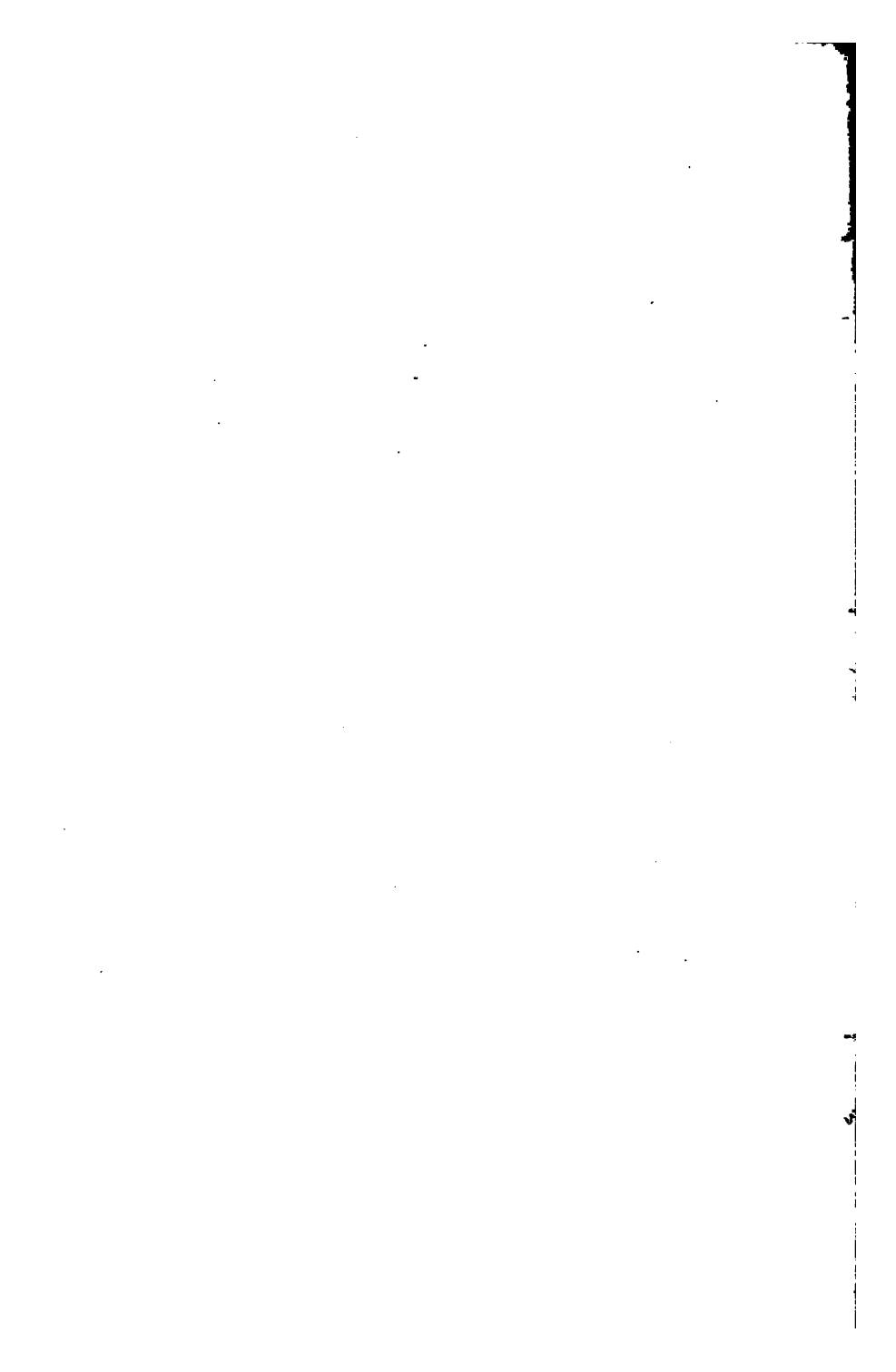
2. On account of the growth increasing slowly in size.
3. On account of discomfort in both breathing and swallowing.
4. On account of the deformity of the neck.

I suggested a trial of electrolysis before having the operation of thyroidectomy, feeling that the latter operation would be a more difficult one in the present case than ordinarily, owing to the inflammatory process set up by the iodine. The patient was referred to Dr. James Henrie Lloyd, who made 15 punctures with the galvano-cautery with a negative result. There was left now but one course to pursue, that of the removal of the growth, which I advised and to which the patient agreed. Accordingly, January 29th, 1891, with the patient under ether, after a careful, tedious and long dissection, I removed the growth. There were many vessels with which to contend, but by far the most troublesome part of the operation, was the attempt to separate the internal jugular vein, owing to its being adherent to the capsule of the goitre. In this attempt the vein was torn at three points. The bleeding was arrested by the application of hæmostatic forceps which were allowed to remain for 72 hours. The pedicle, as well as the blood vessels, were tied with aseptic silk. Following the operation, there was difficulty in swallowing, which was attributed to the manipulation of the œsophagus necessitated by the separation of the growth. An irritative cough and high pulse rate (ranging from 140-

160), persisted for three days. This I believe was due to nerve irritation, consequent upon the operation. Recovery.

Case 4.—E. F. C., 64 years, American. Occupation, farmer. A tumor in the anterior portion of the neck was first discovered by the patient about twenty years ago, during which time its growth has been slow. For the past year its growth was rapid, especially since last summer, since which time the patient has not been able to sleep on his back or right side. He was admitted to the Hospital, March 23, 1891. The tumor, the size of a large foetal head, occupied the anterior or left lateral region of the neck, extending from the angle of the jaw to two inches below the clavicle. There was laryngeal stridor with aphoned and painful paroxysmal of dyspnoea. A diagnosis of cystic goitre was made. Owing to the advanced age of patient, and his general condition, by no means favorable for enucleation, I decided to open and drain. His dyspnoea was so severe it was not advisable to give an anæsthetic until the tumor was aspirated, thus relieving the pressure symptoms. This was done the following day and I drew off a semi-gelatinous fluid tinged with blood. Ether was then given and cyst was opened, and its walls stitched to the skin. This was followed by considerable hæmorrhage which required the packing of the sac with iodoform gauze around the drainage tubes. After this the growth was reduced to the size of an ordinary fist. The patient pro-

gressed slowly, with a temperature fluctuating between 99 and 102°. The pressure symptoms were relieved completely. He is still under observation and now the tumor is the size of a hen's egg and there is a sinuous track occupying the site of the drainage tube.



DEATHS FROM CHLOROFORM AND
ETHER SINCE THE HYDERABAD
COMMISSION. WITH CONCLU-
SIONS.

BY LAURENCE TURNBULL, M.D., P.H.G.,
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We live in an age of wonderful progress ; in nothing is this better proven than in the multiplication of new and valuable books. The works of even one year becoming almost obsolete, new editions and new works taking their place. This is also the case with original experiments and investigations, crowding out the old. Nothing is lacking in either men or money. One of the most munificent works of this kind has recently been undertaken in even far-off India ; the sum of five thousand dollars having been spent by the Nizam of Hyderabad in experiments on anæsthetics alone. This large sum was given, owing to the devoted efforts of Surgeon-Major Lawrie, of the Army of India, who is a great

admirer and believer in the opinions held by the late Professors Syme and Simpson, of the Edinburgh School, in regard to chloroform.

There were two Commissions, one held in 1888, in which 141 dogs were killed by chloroform inhalation, and the symptoms and results of careful post-mortems were made. The chief conclusions which were arrived at, were, "that it is impossible for chloroform vapor to kill dogs by acting primarily on the heart, and this holds good, no matter in what doses, or in what manner the poisoning is induced." These conclusions having been received with doubt by many physiologists, and more especially by the editors of the *London Lancet*, led to the Second Commission, and Dr. Lauder Brunton, a well known author and physiologist, was added to the Commission. The conclusions of the Second Commission were published January 19, 1890. About six hundred animals, chiefly dogs, were employed in the investigations.

"The experiments of the committee were designed to show the effect upon the blood-pressure, heart, and respiration of the inhalation of chloroform, ether, and the A. C. E. mixture, administered in various ways and under varying conditions. The objects of the Commission were five in number :

1. To test the suitability and safety of chloroform as an anæsthetic. The experiments with ether and the A. C. E. mixture were instituted principally for the sake of comparison with

chloroform on certain points, and it is not pretended that they afford a complete exposition of the action of those agents on the system.

2. The effect of pushing the above-named anæsthetics (a) to a dangerous degree, and more especially until the respiration ceases; (b) until death results.

3. The modifications in the effects of these anæsthetics which result from (a) asphyxia in varying degrees and produced by various means, (b) from the use of drugs, such as morphine, atropine, physostigmine, and others.

4. The reality or otherwise of the alleged liability during ordinary chloroform administration to the occurrence of primary or secondary syncope or stoppage of the heart, brought about either by shock or through fatty or weak heart, or by hæmorrhage, or by changes in the position of the body. To investigate these points, in the first place a large number of operations, which are reported to be especially dangerous in reference to shock, were performed in every stage of anæsthesia, and numerous experiments were also made to show the effect of direct irritation of the vagus. Secondly, a number of animals were dosed with phosphorus before they were experimented on. This caused the weakening of the heart by fatty degeneration of its fibres, but at the same time other complicated changes in the whole of the organs of the body, not met with in the condition known as fatty heart in human beings. On the other hand, there are conditions

often found in the fatty heart, such as changes of the coronary vessels, which were not produced by the phosphorus.

5. The effect of the anæsthetics above mentioned upon different animals, more especially upon monkeys, as the nearest approach to human beings."

We will not occupy your valuable time in giving the conclusions of the Commission in detail, but would refer you to the *London Lancet* and other journals which published the report. We will only state, in brief, the practical conclusions arrived at as to the effects of chloroform, "That in every instance the respiration stopped before the heart," and all that was necessary for safety was to attend to that alone. Soon after the publication of the views thus expressed, several practical English chloroformists gave their opinion, founded on professional experience, that chloroform was by no means to be considered safe by simply attending to the respiration, and that the heart still played a most important part in the deaths, as may be seen from the numerous deaths from syncope given in our tables.

With this view, I have made a most careful collection of all the deaths both from chloroform and ether, from every available source, assisted by several friends. These forty-three deaths have been arranged in a tabular form, giving the name, age, history, nature of operation, anæsthesia used, amount used, apparatus employed, posture, how long under influence, whether heart

or respiration stopped first, means to resuscitate, how long continued, post-mortem, cause of death, and references.

The result of examinations and analysis of the table will be found on pages following.*

The whole number of deaths from chloroform and ether are forty-three. Of this number, thirty-nine were deaths from chloroform and four from ether. In five cases, the cause of death was syncope from chloroform, and in thirteen cases the heart stopped first. In ten cases the respiration stopped first, and in four cases the heart and respiration ceased at the same time. In one case cyanosis; no pulse. In twelve of the cases it is not stated which stopped first.

The cause of death in case 37, was due to some peculiar idiosyncrasy. In No. 22, paralysis of the pneumogastric nerve, the direct effect of the chloroform, superinduced by efforts at vomiting. After a careful consideration of the report of this case, and, as there was cyanosis after vomiting, we suspected suffocation, but this cannot be confirmed, as there was no autopsy. In case 20, there was given as cause of death, "Reflex paralysis of the heart," but there was no post-mortem to confirm this statement.

There were twenty-one post-mortems, most of

* In preparing the "Table of the Deaths from Chloroform and Ether, since the Second Hyderabad Commission," we have received the assistance of Professor H. A. Hare, Dr. Joseph Leidy, Jr., and especially the kind labors of Dr. J. Melvin Lamb of the Library of the Surgeon-General's Office, U. S. A., at Washington. Every facility has also been afforded us by the lady Librarian of the College of Physicians of Philadelphia, and to all of these we return our thanks.

them very imperfect. Nos. 24, 25, 36, and 37 were full and complete, and Nos. 15, 19, 21, 28, and 34 were fairly described in this particular. Many of the cases were very imperfect in their detail, especially those from New South Wales.

Sufficient cases are given to show the absolute importance in the method of administering chloroform, and to indicate the necessity of the most careful attention to the pulse and respiration. The only death from anæsthetics in Philadelphia, during the period stated, was one from chloroform (No. 36), while not a single death from ether in the numerous hospitals and operations—indeed we may say in the thousands of operations.

The thirty-nine deaths from chloroform added to the 375, collected by us from our work for Dr. H. C. Wood (contained in his address before the International Medical Congress, at Berlin), make, up to the present time, 414 cases—the actual number being far greater of cases never reported.

The exceedingly small number of deaths from ether, demonstrates its great safety ; still, that it will and does kill (and we notice that the feeble, and persons suffering from malignant disease are more apt to be its victims, see Nos. 10, 11, and 18), we would advise its use as an anæsthetic, and a full study and knowledge of the best modes of using it ; which we judge is not the case in Europe.

It is true that "chloroform acts more rapidly than ether, is pleasanter to take, causes less congestion

of blood in the veins, is much more portable and handy." The last two qualities render it preferable in certain classes of operations, *e. g.* in those on the eye, and in military or traveling establishments. On a campaign it would be impossible to find room to carry ether, or time to use it.

Again, ether cannot be used in hot climates or in close proximity to artificial light; nor is it suitable in certain conditions of the lungs, because ether is more apt to cause suffocation than chloroform, which is given with a much greater admixture of air. Against these advantages on the side of chloroform, ether has only one, which, however, is sufficient to outweigh them all; it is safer.

With regard to occasional unexplained deaths under chloroform, it must be remembered that they occur also under ether, though not so frequently, and used to occur in a similar way before the use of anæsthetics at all. Dr. Brunton also had several accidental deaths; but in every case, "the usual chloroformist was absent, and no one was attending to the chloroform"—a most significant statement. How often might the same be said (with a stress on the word "attending") in our hospital practice! The Hyderabad conclusions really imply a tremendous indictment against the administrators of chloroform—nothing less than that of causing death by carelessness. Unhappily, no one familiar with the administration of anæsthetics can doubt that there is some ground for this. How else account

for the widely differing records of different administrators? Every surgeon knows that with good chloroformists he is perfectly confident and easy, with others the reverse. The last word has by no means been said upon this controversy; but if we may venture a prophecy, it is that the answer to the question "Is chloroform safe?" will eventually be, "That depends on who gives it."

We would refer to the experiments of Drs. H. C. Wood and H. A. Hare (*Medical News*, February 22, 1890), results which are positive proofs in opposition to the experiments and statements of the Commission, that chloroform may arrest the heart before arrest of respiration. In one experiment, breathing continued two minutes after the heart had ceased to act.

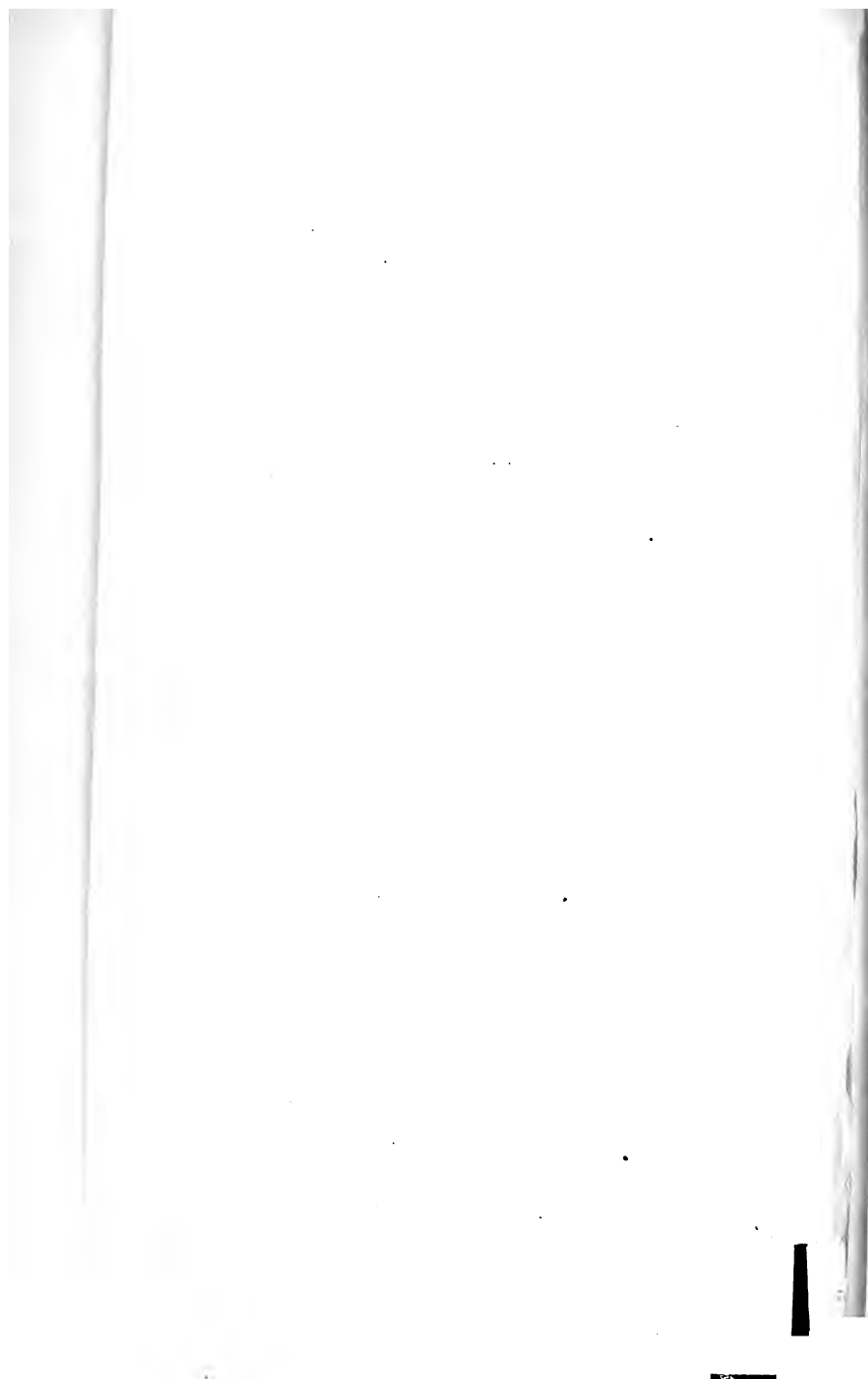
The Pulse During Chloroform Anæsthesia.—A case in point, in which chloroform so depressed the pulse, that ether had to be resorted to. The British Medical Committee (1890) on anæsthetics,¹ after examining the kymographic tracings taken by the Hyderabad Commission, cannot agree with the Hyderabad Commission in holding that there is no danger to the heart during the administration of chloroform. Both committees have found that death occurs by failure of respiration in the great majority of cases, and that chloroform causes a gradual fall of blood pressure, which in itself is a source of danger. Both have also observed that in addition to this

¹ See case in full: *Brit. Med. Jour.* Jan. 21, 1890, p. 1,425.

HER SINCE TH

Long er ence.	Heart or Res Stop First
.....	Heart.
.....	Heart.
.....	Not stated .
.....
July 1	Resp
June not pro- y.	Resp
Sept. mts . . .	"Cyanosis. I pulse."
Nov. 9	Together. . .
Aug. 8 mtes .	Resp
July 12 n min.	Heart.
.....	Together ...
Nov. 10
1890 . es. . .	Heart failure
Jan. 26	Resp.
Feb. 15
April 2
May 17
May 19
Mar. 13	Resp.
Jan. 3,	Heart. Resp ceased a few seconds after

Not failed gradually,
on ceased.



gradual fall, there may be sudden and unexpected falls, with slowing of the heart; but as to the explanation of these falls, they differ. The Hyderabad Commission holds that these falls, during which life is in jeopardy, are caused by asphyxia, while the British Medical Association Committee affirm, that they are due to failure of the heart, due to a specific action of the chloroform upon the organs (from which ether is free). The general conclusion of the British Medical Association Committee is, that while recognizing the great value of the work done by the Hyderabad Commission, and more especially as aided by Dr. Lauder Brunton, they consider that the commission attach too much importance to the most common mode of death from chloroform—failure of respiration—and fail to recognize the danger to the heart that may arise in certain physiological conditions. They consider it unwise and unsafe in practice to pay no attention to the state of the circulation, and to observe respiration alone. Further they consider it unwise to convey to the public, even through the profession, the notion that there is practically no danger in the administration of chloroform.”²

In the *Manchester Medical Chronicle*, January 7, 1891, (page 276), Dr. Lawrie, President of the Hyderabad Chloroform Commission, makes the following statement in answer to Alexander Wilson, and others, in their reviews of the Hyderabad Commission, published in the *Chronicle* of

² British Medical Journal, Editorial, June, 1890.

February 9, 1890. Wilson concludes his review as follows: "Increased knowledge has added nothing new to the direction for its (chloroform) administration." Lawrie states, "The Hyderabad Commission was appointed to confirm or disprove Syme's and Simpson's principles, that we should be guided as to the effect of chloroform entirely by the respiration. The Commission has not only proved that these principles are sound, but has also proved that the art of administering chloroform with safety consists in keeping the breathing absolutely regular throughout the inhalation. This proof is new, and has never been established before. After criticising the teachings of Wilson, he states that the Commission has shown, 1, that the lowering of the blood pressure, which chloroform and all anæsthetics cause when efficiently administered, is in itself a harmless event, if the respiration alone be attended to and taken as a guide, and if the administration be stopped when the patient is fully anæsthetised; and 2, that the sudden falls of pressure, which the Glasgow Committee asserted, are dangerous, and attributed to chloroform, are due to stimulation of the vagus, and, by slowing the circulation, are a safeguard against overdoing.

The Commission further proved that all irregularities in the fall of the blood pressure, and in the circulation under chloroform, including such an irregularity as dilatation of the heart, which occurs when chloroform is administered properly, are due to improper administration with irregu-

lar breathing and insufficient air (page 277). Again (page 278), every medical man ought to be able to give a dose of chloroform with as much precision, as certainly as a dose of morphine, or of any other poison. The practical outcome of the disastrous teachings of the Glasgow Committee, backed up by Professors Wood and MacWilliam, is, that the relief of pain by chloroform is to be handed over to the specialists, who alone are to administer it, though their own declarations and statistics show that they cannot give it with safety. Exactly in proportion as this teaching gains ground, the profession suffers loss in credit, and in pocket, and the advantages which chloroform confers are most seriously restricted and curtailed.

The extensive experiments of the Commission have left the chloroform question in the following condition:

It was not found possible to directly paralyze the heart (of dogs) by chloroform in some 600 administrations. Death from chloroform is due apparently from paralysis of the vaso-motor and respiratory centers—probably one or both of these may be affected. When death occurs, it is the result of an overdose of the drug.

The most conclusive statements and experiments are given in the paper of Dr. McWilliam in answer to the strictures and conclusions published by Dr. Lawrie.

In the *Medical Chronicle*,³ January, 1891, Sur-

³ *Medical Chronicle*, Manchester, 1891, xiii, 352-355.

geon-Major Lawrie, in an article on the Hyderabad Chloroform Commission, makes some comments on certain results obtained by me in a recent investigation on the action of chloroform and ether published in the *British Medical Journal*, October 11, 18, and 25, 1890.

In my paper I described the frequent occurrence of dilatation of the whole heart under the influence of anæsthetic doses of chloroform. Such dilatation was not due to changes in the pulmonary circuit, or to fall of arterial pressure.

Dr. Lawrie urges that the cardiac dilatation was due to obstruction of the circulation of the lungs, or to this along with a fall in the blood pressure. He says: "The irregularities in the tracings of the Glasgow Committee, and Professor McWilliam's recent bogie of dilatation of the heart, are due to obstruction of circulation in the lungs through interference with, or irregularity of, the respiration." And later. "Obstructed circulation in the lungs, and a rapidly falling blood pressure, are more than enough to account for the dilatation of the whole heart, which occurred in his experiments, and which he wrongly attributed to the direct action of chloroform."

Nor can this hypothesis of Surgeon-Major Lawrie's be briefly and conclusively disposed of. There is an abundance of decisive evidence available. First, as regards the alleged influence of obstruction of the circulation in the lungs, in causing dilatation of the heart. In my paper, in the *British Medical Journal*, I stated the fact

that such an explanation was incompetent to explain the cardiac condition, since the whole organ was dilated in my experiments. Dilatation of the right side of the heart might conceivably (if there were no evidence to the contrary) be accounted for by the pressure of pulmonary obstruction, but dilatation of the left side (*e. g.* the left auricle) could clearly not be accounted for in the same way, since pulmonary obstruction necessarily diminishes in a large measure the flow of the blood into the left auricle, and this part becomes small and collapsed. This seemed so obvious to me, that I did not discuss the matter at any great length.

I shall now state, briefly, some facts in regard to Surgeon-Major Lawrie's hypothesis of obstructed circulation in the lungs:

1. There is no proof whatever of the occurrence of pulmonary obstruction from the administration in mammals of anæsthetic doses of chloroform, sufficiently diluted with air, as was the case in my experiments, the amount of chloroform vapor in the air never exceeding four per cent.

2. On the other hand, there is decisive proof that pulmonary obstruction was not present in my experiments. Obstruction of the circulation would necessarily cause distension of the pulmonary artery as well as, and indeed earlier than, distention of the right heart. The pulmonary artery would become large and tense in consequence of the increased peripheral resistance to

the outflow of blood from that vessel. Then the increased tension would react upon the right heart and cause distension there also. But in my experiments there was no distension of the pulmonary artery during the administration of chloroform. The vessel did not become distended; it was soft and compressible, and the tension within it was low. It is quite certain, then, that pulmonary obstruction could not have been the cause of the dilatation, even on the right side of the heart.

3. Even if pulmonary obstruction had been present—as was not the case—such obstruction could not have produced the condition which I described, or anything similar to it.

I have on various occasions purposely brought about a condition of pulmonary obstruction by mechanical means with a view to studying the features of this condition. This I did by injecting into one of the great systemic veins some particular substance, *e. g.* lycopodium powder, which would cause embolism of the pulmonary vessels and so obstruct the circulation in the lungs. When such a substance is injected into the vein, it rapidly passes through the right heart into the pulmonary vessels, speedily causing more or less extensive and sudden obstruction of the pulmonary circulation, according to the amount and suddenness of the injection.

The effects resulting from the plugging of the minute pulmonary vessels induced in this way are very noteworthy, and illustrate clearly the consequence of obstruction of the circulation of

the lungs. The pulmonary artery swells up and becomes largely distended, while at the same time the vessel feels hard and tense to the touch; the pressure within the vessel is greatly elevated. The right ventricle, and the right auricle also, partake in the condition of distension, being unable to discharge their contents in the normal fashion in face of the greatly augmented resistance in front. The lungs become pale and anæmic. Meanwhile it is important to observe that the left auricle becomes smaller and collapsed-looking, in consequence of the obstacle offered to the passage of the blood through the lungs. Strong respiratory efforts, with convulsions of the asphyxial type (accompanied by spasmodic contraction of the systemic arteries) supervene in consequence of the stoppage of the respiratory purification of the blood; the medullary centres become violently stimulated by the venous character of the blood. Death speedily follows.

It is unnecessary to enter closely into a comparison, or rather contrast, of the typical illustration of pulmonary obstruction here afforded, and the condition of cardiac dilatation which I have described as occurring under the influence of chloroform. It is obvious that obstruction of the circulation in the lungs produces changes strikingly different from those that result from the action of chloroform; and that the hypothesis of pulmonary obstruction may at once be dismissed as entirely insufficient and inapplicable,

as far as explanation of the cardiac dilatation occurring under chloroform is concerned.

Seeing that it is easy to dispose of the question of pulmonary obstruction in regard to the effects of chloroform upon the heart, I shall now advert briefly to the possibility of cardiac dilatation being dependent on a rapidly falling blood pressure, as alleged by Dr. Lawrie.

This is a matter which I carefully considered in my paper, and in regard to which I was able to state definitely that the cardiac dilatation is not due to a fall of blood pressure. This is conclusively proved by the following facts: 1. Dilatation of the heart does not by any means always run parallel to the fall of pressure which ordinarily results from the administration of chloroform. Sometimes there is a very marked fall of pressure, with little or no dilatation of the heart; while at other times, the heart begins to dilate, before the pressure begins to fall. 2. Moreover, the heart in some instances begins to dilate during the temporary rise of pressure which at times precedes the fall. 3. Further, there may be distinct dilatation of the heart without any change of pressure at all. 4. Lastly, it can easily be shown that a simple fall of pressure, equal in amount to that which ordinarily occurs under chloroform, induced by means which do not directly affect the heart—*e.g.*, section of a vaso-motor nerve, hæmorrhage, etc—does not cause dilatation of the organ as chloroform does.

It is clear, then, that the dilatation of the heart

brought about by chloroform cannot be due to obstruction of the circulation in the lungs, or to a fall of systemic blood pressure; it must result from a depressing influence exerted by the anæsthetic on the organ, 1, directly; or 2, through the vagus nerves.

Finally, as this depressing influence, leading to dilatation, is readily manipulated after section of both vagi, it is obvious that chloroform must act upon the heart directly. I cannot help feeling that even a comparatively slight amount of actual observation of the features and results of a simple lowering of the blood pressure and of real pulmonary obstruction, would have prevented Surgeon-Major Lawrie from putting forward and adhering to such a hypothesis as I have here discussed—a hypothesis at once insufficient, absolutely untenable, and in conflict with large and somewhat elementary facts in the physiology of the circulation.

RESTORATION AFTER CHLOROFORM ASPHYXIA.

There is no doubt that in India deaths do occur (see case No. 43) from the administration of chloroform, yet we know from the facts stated in our work, that the climate of that region, like that of our Southern States, is favorable to its use as an anæsthetic. Recently there has come to our notice, while in search for facts on the subject of prevention of deaths from chloroform, the following cases and opinions of practical surgeons,

which we consider worthy of your most serious attention.

Two cases of chloroform asphyxia were reported by Surgeon-Major Bartholomew and Civil Surgeon Ahmedabad. *a.* A patient aged 31, thin and emaciated, had suffered eight years from vesical calculus. He was operated on and the stone, weighing 50 ozs., extracted, when it was observed that respiration had ceased. Ether hypodermically and the usual remedies were used without effect, and artificial respiration (Sylvester method) continued for three hours before the patient took a long breath (the heart action, though feeble, had not ceased). Six drachms of chloroform had been given.

A patient aged 18, had had 5 drachms of chloroform given prior to enucleation. After the operation the breathing was observed to have ceased, and the patient could not be roused. Artificial respiration was carried on for one hour, and on giving a galvanic shock, the patient recovered consciousness. Drs. Pechey, Phipson, Banks, Maconachie, Meyer and Collee, all of the Army of India, cited instances in their experience of prolonged chloroform asphyxia, and ultimate recovery by artificial respiration and the galvanic shock. Dr. Meyer stated, that there was a danger of inducing delirium of the heart by the prolonged use of electricity (this is the case when applied too near the heart), and thereby superadding a serious complication which might in itself prove fatal. Frequently patients

did not breathe for some time after artificial respiration, because the lungs had had such a large quantity of air thrown in as to do away with the physiological reflex stimulus to the respiratory centre.

We do not in our work advise the use of hypodermics of morphine or atropine before the use of chloroform as an anæsthetic, and would call attention to this case, also, as the surgeon did not employ the galvanic shock, and did not keep up the artificial respiration long enough.

In a discussion which took place in the Paris Society of Surgery, upon a paper⁴ treating of the use of hypodermics of morphine and atropine before the inhalation of chloroform, the author of the paper, M. Regnier, was led to try this method in his practice by the recommendation of M. Dastre, who reported favorable results from its use in animals, and of M. Aubert, a surgeon, who stated that narcosis and awaking were facilitated by the injection of $\frac{1}{4}$ gr. morphine muriate and $\frac{1}{8}$ gr. atropine sulphate fifteen or twenty minutes before the operation, and that inconvenient results were observed but rarely. M. Regnier used this method with a number of patients, until, unfortunately, a fatal accident occurred.

A feeble girl, aged 16, was affected with tubercular disease of the bones of the foot, and, as the lungs presented but a few râles in the apex of one side, he decided to chisel out the cuboid bone. Half an hour before the operation he gave a hy-

⁴ L'Union Médicale, August 5, 1890.

podermic injection of $\frac{1}{12}$ gr. of morphine and $\frac{1}{250}$ gr. of atropine. Anæsthesia was easily induced, and not more than from 5 to 7 fluid drachms of chloroform were required for the whole operation, which lasted only a few minutes. About ten minutes after the chloroform had been removed, and while the dressings were being applied, she opened her eyes without speaking, and was then carried to her ward. Three minutes later news was brought that she had ceased breathing. Upon reaching her bed he found the respirations very infrequent. They ceased suddenly as the pulse disappeared, although feeble heart-beats were still heard. The pupil then quickly dilated. Protracted artificial respiration seemed, at the end of half an hour, to excite spontaneous respiration, but this soon failed, although supplemented by ether injection and other measures. Post-mortem examination showed anæmia of the cerebral hemispheres and medulla oblongata.

Death in this case came on very slowly from chloroform intoxication. It was quite remarkable that life could be prolonged for more than twenty minutes by artificial respiration. It was claimed that the chloroform must have been eliminated slowly, and that the elimination was rendered more slow than it would otherwise have been by the influence of the morphine and atropine.

Two members of the Society reported that they had observed, in experiments on dogs, that mor-

phine and atropine given before chloroform, produced no reflex phenomena at the beginning, but rendered much more grave such complications as appeared at the end. In some cases there was quite protracted and severe dyspnoea. In dogs thus treated, very little chloroform was needed; in men more was required. It appeared to be conceded that the method was useful in the laboratory, but not in the clinic, as the chances of intoxication were increased.

Another member who had tried the method, stated that in male patients nothing worthy of note was usually observed; while in female patients, the awaking was much more slow than with chloroform alone. He thought women were more sensitive than men to the influence of atropine. Out of five cases he had lost one patient. The operation was for nephrectomy, and lasted an hour, 15 fluid drachms of chloroform being used. After a short awakening the respiration began to fail, cyanosis appeared, and in spite of all measures, death occurred in an hour and ten minutes.

CONCLUSIONS.

1. During the protracted use of chloroform as an anæsthetic, the blood is changed in character, lowered in pressure, with weakening of the action of the heart and changes in its structure.
2. Dilatation of the heart occurs under the use of chloroform at all stages, on both sides of the heart, while the heart muscle is weakened.

3. Cardiac failure occurred before respiration in thirteen instances out of forty-three cases of death from chloroform.

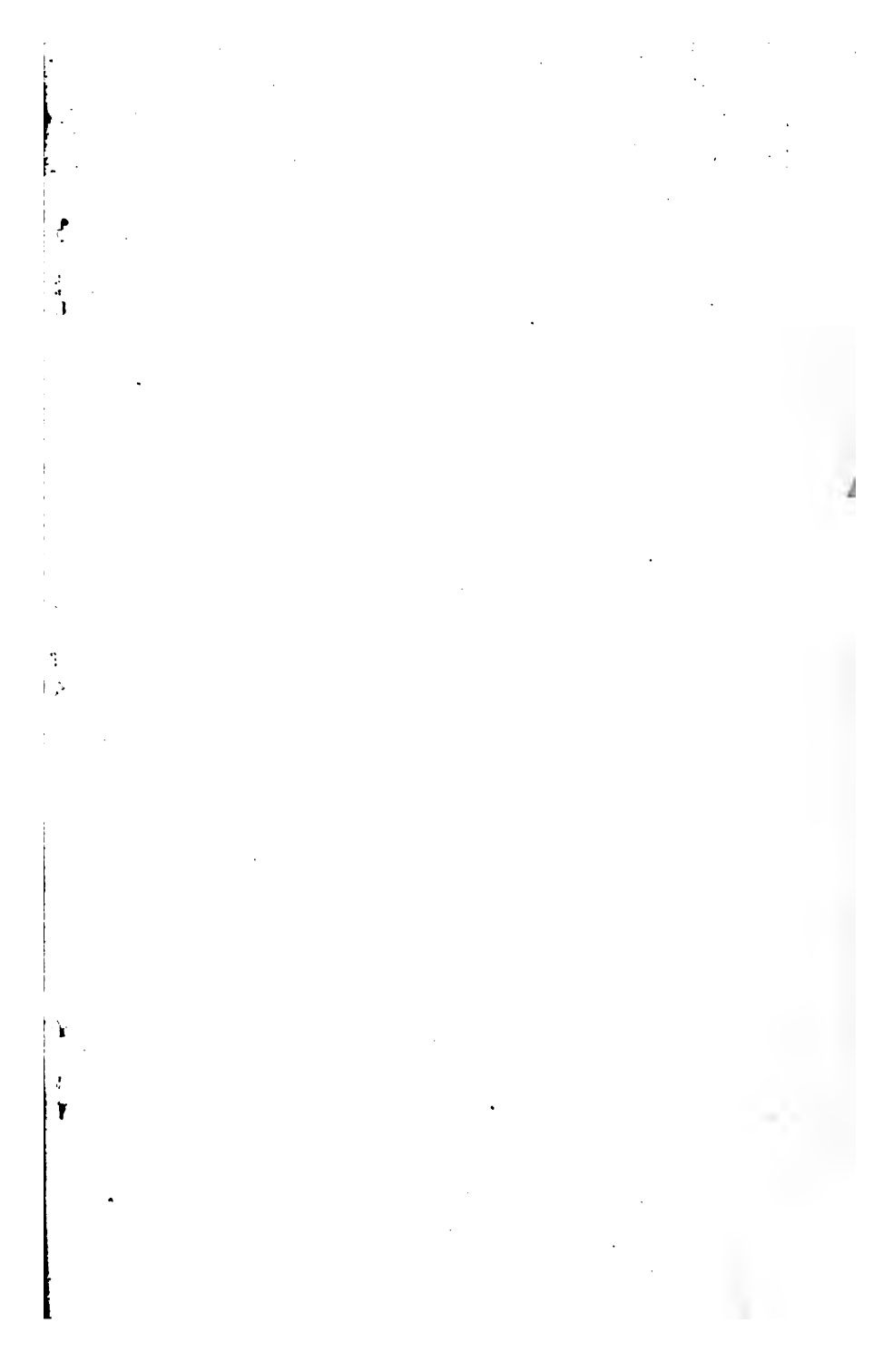
4. The depressing influence of chloroform on the heart mechanism is not exerted through the vagus nerves, and section of both vagi does not obviate the weakening and dilating influence of chloroform on the heart.

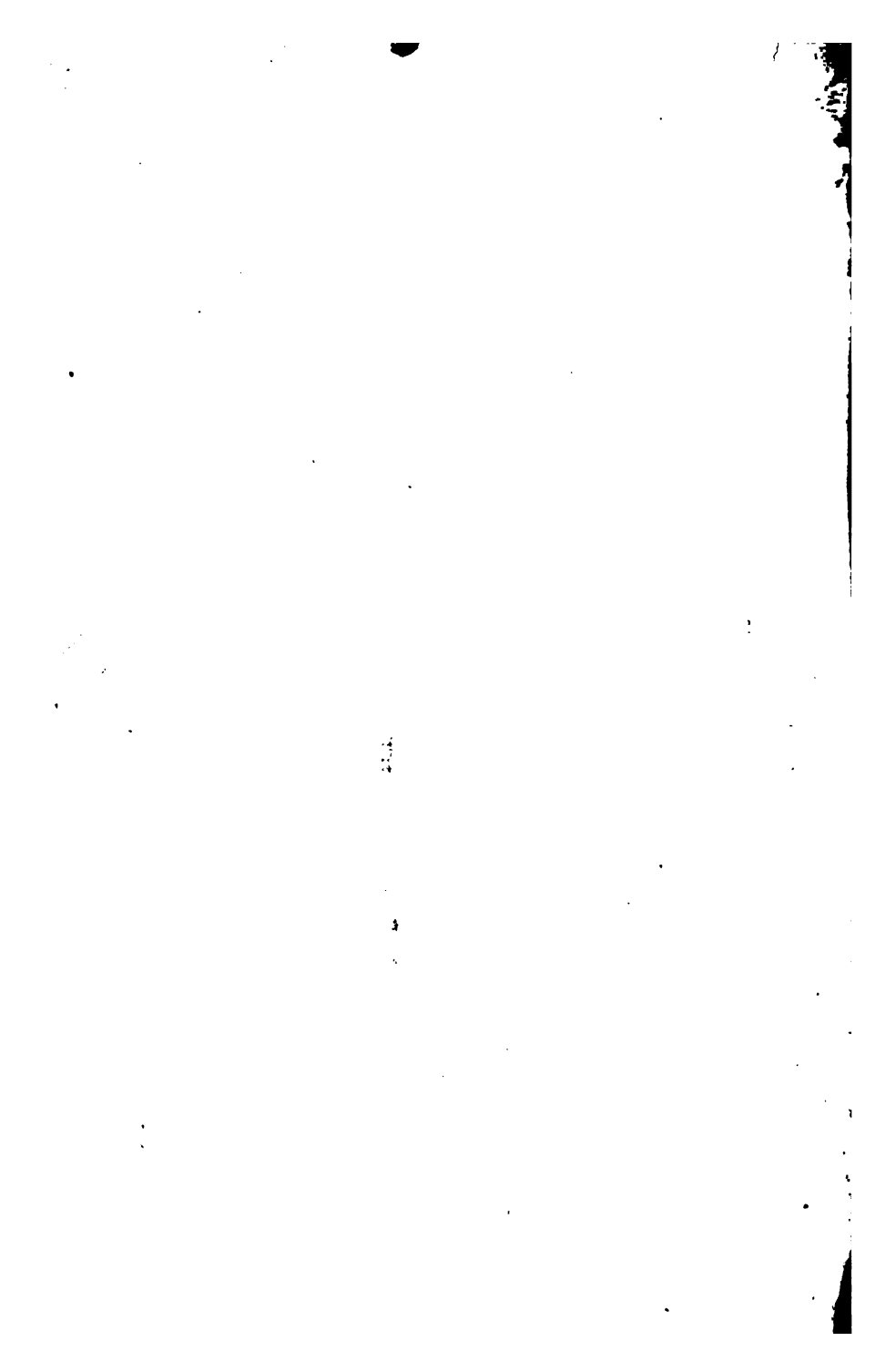
5. Too many trifling operations are performed under chloroform; its use should be reserved for those cases in which ether, nitrous oxide, or cocaine will not produce the anæsthesia desired.

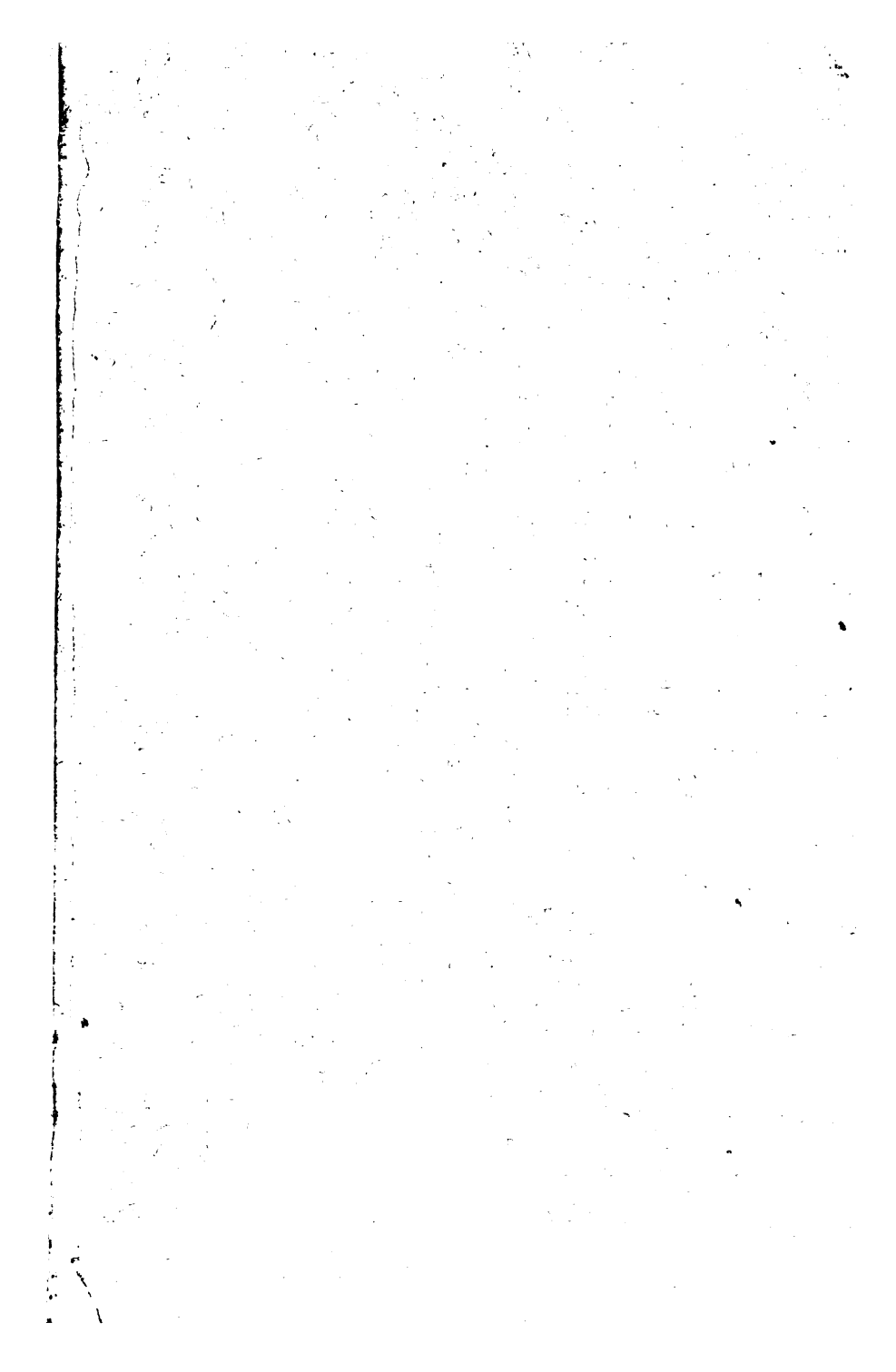
6. Ether deaths, as a rule, occur in patients of a certain class, usually from obstructed respiration, and occasionally the heart will stop first, as in two of the four cases in our tables.

7. Watch both pulse and respiration, both in chloroform and ether; when the breathing becomes very rapid, danger is near.

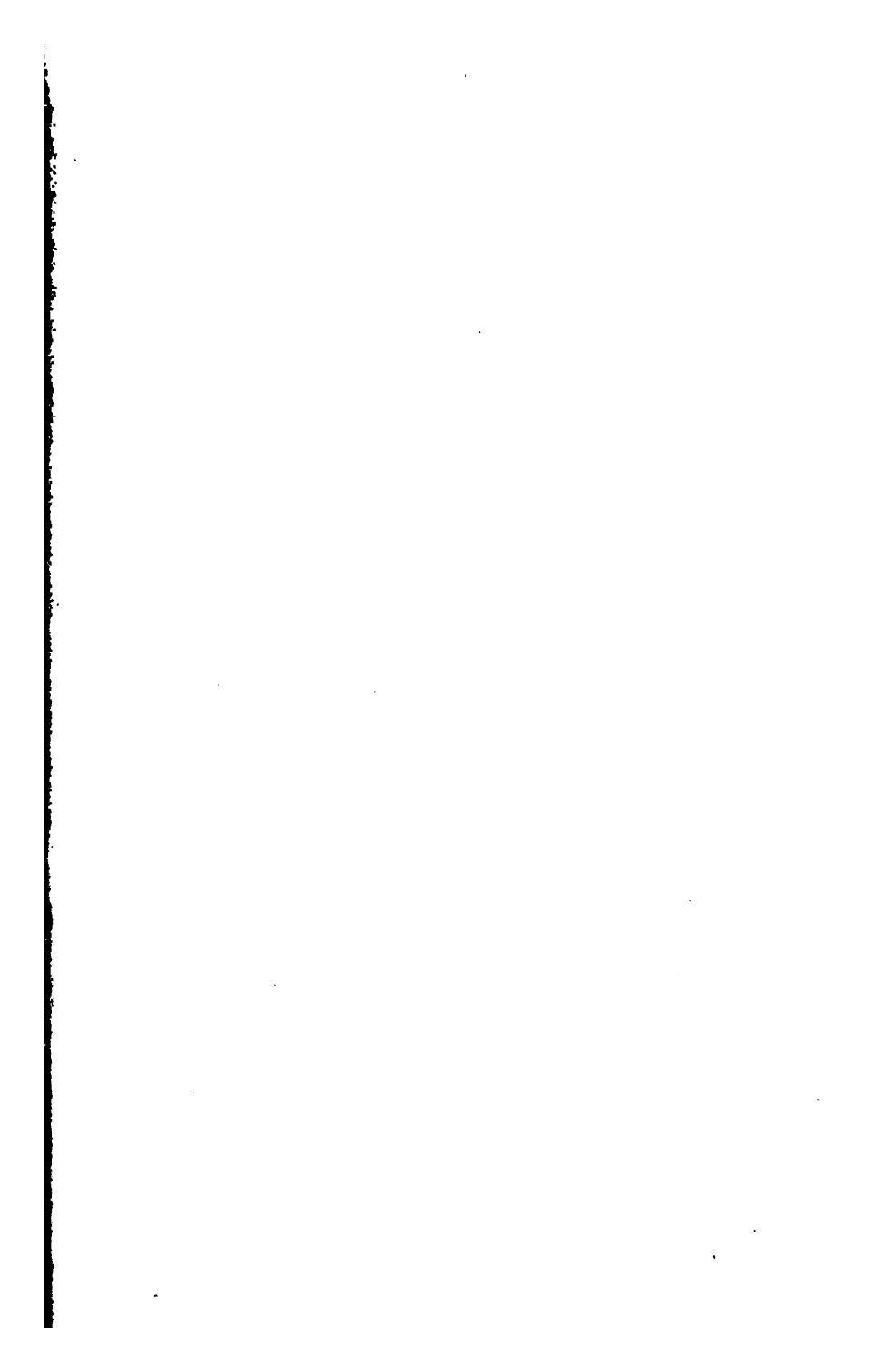
These changes are apt to follow the first act of respiration. Chloroform vapor should not be employed over 4 per cent.











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